



AT THE
FRONT DOOR OF CANADA.

THE GREAT WORKS OF THE
DOMINION IRON AND STEEL COMPANY,

AT SYDNEY, C. B.

The Most Favourable Situation in the World
for an Iron Industry.

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A SERIES OF ARTICLES WRITTEN FOR
The Montreal Daily Star,

. BY .

WATSON GRIFFIN.

MONTREAL :

DOMINION PRINTING COMPANY, 1838 Notre Dame Street.

1899.

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A BIG THING FOR CANADA.

From the Montreal Daily Star, September 15, 1899.

OR the last thirteen years the Star has been advocating the development of Canadian iron and steel industries. It has long been known to readers of geological reports that British North America is wonderfully rich in iron, and the Star has frequently urged the Canadian Government to take steps to secure the development of our iron resources, because iron is the raw material of so many manufactures that all industries depend, directly or indirectly, upon it, and no country can be industrially independent without a home iron industry. A study of the industrial development of other countries showed that no country had ever established a great iron industry without the stimulus of protective duties or bounties. The Conservative Government, in framing the National Policy tariff of 1879, while affording protection to many industries, failed to apply the principle to that industry which is the basis of nearly all others. In the year 1886 the Star published a series of editorials calling upon the Government to rectify this defect in the National Policy, and, as it was expected that the tariff would be revised during the Parliamentary session of 1887, a member of the editorial staff was sent to Cape Breton and other coal mining sections of Nova Scotia to write up the question of the value of an iron industry from the standpoint of the coal mines, the purpose being to show how much the coal miners would be benefited by the establishment of an iron industry. A series of articles was published extending over a period of some

weeks, and marked copies of the Star containing these articles were sent to every member of Parliament. Sir Charles Tupper was then Minister of Finance. He was the first of our public men to appreciate the necessity of developing an iron-making industry, and in his budget speech he announced that it would be the policy of the Government, by protective duties and bounties, to encourage the establishment of blast furnaces and steel mills.

The development of an iron industry is always a slow process in its early stages. Mines must be opened, ores tested and transportation provided. Then it requires a very large investment of capital to carry on the industry, even upon a small scale. A blast furnace is very costly, and it takes a long time to build one. With all the millions at the command of the newly organized Dominion Iron and Steel Company, it will be impossible to get a single blast furnace in operation in a shorter period than sixteen, and perhaps eighteen months from the time of giving out the contract.

Although protective duties and bounties were granted in 1887 there was such bitter opposition to this policy that it was difficult to induce capitalists to invest upon a large scale because they feared that a change of Government might result in the abandonment of protection before they could get their works in operation. However, it was not long before the good effects of the new policy began to be seen. A blast furnace using coke as fuel was built at Ferrona, in Pictou county, N. S., by the Nova Scotia Steel Company, and a charcoal furnace at Radnor, Que., by the Canada Iron Furnace Company, both of which produced excellent iron that soon obtained a reputation even outside of Canada. But the development of a great Canadian iron industry was delayed owing to the fact that a world-wide depression existed in the iron industry and prices were abnormally low for some years.

The Ontario Government, seeing the good effects of the Dominion Government's iron policy, supplemented the Dominion duties and bounties by a provincial bounty. The first furnace to go into blast in Ontario was the one at Hamilton which proved a success although it had to bring both coke and ore from a distance. Then the Rathbuns built a charcoal furnace at Deseronto and another charcoal furnace is now being built by the Canada Iron Furnace Company at Midland, on Georgian Bay, which is considered a most favourable point for assembling the raw materials, as charcoal and limestone can be obtained near at hand, while the ore can be brought in the largest lake vessels from the north shore of Lake Superior.

The future of the Canadian iron industry is very promising. Prices of iron and steel are now very high throughout the world, and the best authorities are of the opinion that they will not for many years reach the abnormally low figures which prevailed for a few years. The Liberal Government has wisely decided to accept the Conservative policy of encouraging the iron industry. At the last session of Parliament Mr. Fielding, Minister of Finance, with the hearty approval of Sir Charles Tupper, announced that the period for which bounties would be granted would be extended until the end of the year 1907. By that time we believe that Canada will have a number of great iron and steel making establishments of which the Canadian people will have reason to be proud. The greatest of them is likely to be that of the Dominion Iron and Steel Company at Sydney, C. B. The Star man who visited Cape Breton in 1887 was particularly impressed with the natural advantages afforded by the proximity of coal, limestone and iron ore, and he then predicted that somewhere in the vicinity of the coal mines tributary to the harbours of Sydney and Louisburg a great iron and steel industry would eventually be established. This prediction is now about to be realized, and the Star, believing that the investment of so many millions of dollars in Cape Breton will create an industrial revolution not only in that island, but throughout the Maritime Provinces, and that all Canada will be benefited by it, proposes to publish a series of articles under the heading "At the Front Door of Canada" describing this great undertaking, which will be far the biggest industrial enterprise in Canada. These articles, the first of which will appear in to-morrow's issue, should be read by all Canadians who are interested in the development of the country. No business man can afford to be ignorant about the iron industry, because all lines of business are affected by it. As the Star has already pointed out, many business men who do not use iron, watch the prices of iron and steel, considering that they make the best trade barometer, and use them as a guide in making all kinds of investments.

The Wonderful Geographical Situation of Sydney, C. B.

From the Montreal Daily Star, September 16, 1899.

I.



SINCE the building of the Canadian Pacific Railway no enterprise has excited such general interest in Canada as the organization of the Dominion Iron and Steel Company, which proposes to manufacture iron and steel at Sydney, Cape Breton, in the Province of Nova Scotia. The immense amount of money that is being expended in the construction of the works, and the fact that the capital for the undertaking is being furnished by a combination of the wealthiest men in Canada and the United States, men who have never been known to fail in anything that they have undertaken, has excited widespread curiosity. The eyes of the Canadian people have heretofore been turned westward. The development of Manitoba, the North-West territories and British Columbia has been watched with keen interest by the whole people and almost every man, woman and child in the Dominion has felt a personal interest in the progress of that great western country. There is no doubt that the people of the eastern and central provinces will always continue to have a common national pride in the North-West, but the West will not engage the exclusive attention of our people in the future as it has in the past.

Those who wish to watch the development of Canada must look to the East as well as to the West. Few Canadians as yet realize the great natural resources of the Maritime Provinces and the wonderful geographical advantages they possess for a world wide commerce. These provinces have the same geographical relation to the continent of North America that the British Isles have to the continent of Europe. They jut out into the Atlantic far to the east of North America just as the British Isles lie out in the Atlantic to the west of Europe. The area is nearly as great as that of England and Wales, and if Newfoundland be included the area is a little greater than that of England, Wales

and Scotland. The natural resources of the Maritime Provinces are probably almost as great as those of the British Isles before they were developed, and greater than those of the British Isles at the present time, for the minerals of the United Kingdom have been to a considerable extent exhausted, while those of the Maritime Provinces have scarcely been touched, and their fisheries are acknowledged to be the richest in the world. The fact that the resources of the Maritime Provinces have been neglected, while other parts of the continent have been developed should not be a reason for discouragement regarding the future of these provinces. The British Isles were undeveloped and had but a small population at a time when some of the countries of continental Europe were rich and populous centres of industry and commerce.

The Maritime Provinces might also be compared with the New England States. Including Newfoundland, the area of the Maritime Provinces is 90,414 square miles, as compared with the 62,005 square miles of the New England States. Excluding Newfoundland and Maine, we may compare Prince Edward Island, Nova Scotia and New Brunswick, which have an area of 50,214 square miles, with Massachusetts, Rhode Island, Connecticut, New Hampshire and Vermont, having an area of 32,110 square miles and a population of over four millions. The New England States have no coal, few valuable minerals and only limited areas of fertile land.

Prince Edward Island, the smallest province of the Dominion, lies at the south of the Gulf of St. Lawrence, and is separated from the mainland by Northumberland Strait. It is 150 miles in length, varies in width from four to thirty miles, and has an area of 2,133 square miles, almost every foot of which is suitable for cultivation. The soil is naturally very fertile and the island has a unique advantage in the possession of inexhaustible supplies of natural manure in the form of mussel mud, formed by the decay of oyster, clam and mussel shells in all the bays and river mouths. A good dressing of this mussel mud is said to have a marvellous effect in restoring fertility to the poorest soils. The chief crop of the island is potatoes, but all kinds of grains and vegetables are produced in abundance and all the fruits of the North temperate zone, excepting peaches and grapes can be successfully grown. A large cheesemaking industry has been developed within the last five years. The fisheries are valuable and the islanders are devoting special attention to the cultivation of oysters. The island is practically without mineral resources, although coal is believed to exist at a great depth. The climate is by no means severe, and the atmosphere is clear, fogs being seldom experienced. In January and February the thermometer sometimes registers as low as fifteen degrees below zero for a few hours at a time, but such cold is exceptional, the average of all temperatures during January and February for seven years being nearly seventeen degrees above zero. The Province of Nova Scotia is three hundred and eighty-six miles in length, by from

fifty to one hundred miles in width, with an area of 20,907 square miles, and extends from the 43rd to the 47th parallel of latitude. The coasts of the mainland are rugged and uninviting in appearance, and Mr. Herbert Crosskill has compared the province to a splendid painting in a coarse iron frame, but the rough-looking frame, with its minerals, its many commodious harbours and rich fisheries, is as valuable as the fertile interior.

Owing to its almost insular position and perhaps to the influence of the Gulf stream, which flows not far from its southern extremity, the climate of the greater part of the province is much more moderate than that of the neighbouring State of Maine. Extreme cold is seldom experienced in any part of the province, but the northern counties are more exposed to the influence of the Arctic current flowing through Belle Isle than those in the south and along the Bay of Fundy. Thus, Annapolis township, where the climate averages about six degrees warmer than that of the State of Massachusetts, is seven or eight degrees warmer on the average than the counties in Cape Breton and along Northumberland Strait, five or six degrees warmer than Halifax and Colchester counties, and three or four degrees warmer than the famed country of Evangeline along the Basin of Minas. At Yarmouth, the most southern town in Nova Scotia, the minimum temperature in an average winter is 1.3 degrees above zero, while the average of all temperatures in January and February for seven years was 25.4 degrees. But the summer temperatures are lower than those of the Annapolis Valley. In Sydney, Cape Breton, near the north end of the province, the thermometer sometimes touches thirteen below zero, the average of all temperatures for January and February for seven years being 18.9 degrees above zero, while at Halifax about half way between Yarmouth and Sydney, the greatest degree of cold experienced in an average winter is between six and seven degrees below zero, the average of all temperatures at that point during January and February for seven years being twenty-two degrees above zero. The winters are short, but except in the south-western counties the spring is long and backward owing to the chilling influence of the ice that drifts through Belle Isle. But there is some compensation for the backward spring in the beautiful autumn.

The garden of Nova Scotia is in the Annapolis and Cornwallis valleys, a district about eighty miles long and from four to twelve miles wide, protected from the summer fogs of Fundy and the chilling ocean winds by two ranges of hills known as the North and South Mountains. The North Mountains skirt the south shore of the Bay of Fundy from Briar Island to the Basin of Minas, terminating in a bold bluff called Cape Blomidon. On the other side of Minas channel, the range is continued under the name of the Cobequid mountains, acting as a shield against the cold winds coming from the Gulf of St. Lawrence in the spring. The apples of the Annapolis Valley command a higher price in the English markets than those grown in any other quarter of the world. In this valley and its extensions there are

already about forty thousand acres of apple trees, and it is estimated that there are nearly four hundred thousand acres capable of producing the very finest fruit. While the climate and soil seem particularly adapted to the production of apples, they are also favourable to grapes, melons and tomatoes, and peaches have been successfully grown. King's county, the scene of Longfellow's *Evangeline*, although not quite so warm as Annapolis township, is equally fertile, and the dyked lands appear to be as productive now after centuries of tillage, as when they were cultivated by the simple Acadians. All the other counties bordering on the Basin of Minas and those lying along Cumberland Strait and the Gulf are good agricultural districts. Excepting Yarmouth, none of the counties along the Atlantic coast are generally well adapted for agriculture, although they contain small tracts of excellent farming lands, and no doubt much of the land, now considered unsuited for cultivation could be made productive under a system of scientific farming and the use of fertilizers.

The gold bearing rocks of Nova Scotia extend along the Atlantic coast from Canso to Yarmouth, and are estimated to cover about three thousand square miles. Very little capital has been invested in their development, but nearly twenty thousand ounces of gold are annually extracted. Silver, copper, tin, lead, manganese, plumbago and gypsum have also been found in the province, but have not yet been extensively mined. But Nova Scotia has most reason to thank Nature for the stores of coal and iron with which the province is so richly endowed. The known productive coal fields occupy an area of 685 square miles, the veins being of extraordinary thickness, and there are believed to be considerable areas as yet unproved. All the different varieties of iron ore have been found in the province, and some of the deposits are very extensive.

Along Nova Scotia's five hundred miles of sea coast are the breeding and feeding grounds of countless millions of fish. Prosperous fishing villages are found all along the rough-looking coast, and the annual catch is greater than that of any other Canadian province. The timber resources are great, and extensive lumbering operations are carried on.

New Brunswick adjoins the State of Maine and is in many respects its counterpart, but it has a much longer coast line, and the surrounding waters tend to moderate its climate somewhat.

The most noteworthy feature of the province is its extensive system of navigable rivers and lakes, giving almost every section communication with the sea. The total area of the province is seventeen million acres, and thirteen million acres are estimated to be suitable for agriculture. Millions of acres in the most fertile sections still remain unoccupied, and can be obtained by settlers as free grants or purchased at very slight cost. All kinds of grains and vegetables thrive in New Brunswick; apples and pears are successfully grown, while the smaller fruits, such as cherries, raspberries and blackberries, are raised in great

quantities. But the province seems to be particularly adapted for stock raising and dairying, on account of the luxuriant pasturage and unfailing supplies of water.

New Brunswick not only has extensive sea fisheries, but its inland waters are full of salmon, trout and other fish which are very attractive to sportsmen. There are millions of acres of trees that have never been touched by the axe. These forests are so near to navigable rivers connecting with the sea that the facilities for exporting lumber and making pulp are unequalled. Iron ores are found in abundance in various parts of the province while antimony, copper, manganese, lead, silver, gold and tin have been discovered, but very little capital has been invested in their development and the value of the deposits is unknown.

The climate of all parts of the Maritime Provinces is remarkably salubrious, and it is claimed that the average of life is longer than in any other quarter of the globe. According to the census of 1891 in a population of 880,737 for the three provinces there were 16,961 over seventy-five years of age and 8,098 over eighty years of age.

With such great natural resources and such a wholesome climate, why is it that there are less than a million people in these provinces? The chief reason is lack of capital to develop the resources, and lack of confidence on the part of the people. There are few local manufacturing industries, and hundreds of thousands have gone to the United States to seek employment. The products of the farms are shut out of the industrial centres of the United States by high duties, and the fact that they are nearer to Europe than any other part of America is of little advantage at present, because there are no great steamship lines in summer to carry their products to the British market. In this respect the farmers of Ontario, although much farther from England, have an advantage for they can ship their products by the great steamships that run from Montreal to British ports.

The announcement that great iron and steel works are to be established at Sydney has had an extraordinary effect upon the people throughout these provinces. A Montreal business man who has just returned from a trip to the East says that this great enterprise is talked of everywhere, and that a feeling of confidence is being aroused by it that will help all lines of business. There is a rapidly growing belief that capital is at last to flow freely into the provinces to develop their great natural resources. Mr. Henry M. Whitney, President of both the Dominion Coal Company and the Dominion Iron and Steel Company, has great confidence in the future of the Maritime Provinces and it will be to the interest of his companies to promote their development, for a large population in these provinces would make a local market for the products of the blast furnaces and steel mills. Moreover, if steamship lines ran from Charlottetown, Halifax, Yarmouth and St John to Sydney during the summer months the products of all sections of the provinces might be collected at Sydney for

shipment to Europe, South America, Africa and Asia in great cargo ships, together with pig iron and steel, just as the lake vessels and railways bring the products of Ontario and the North-West to Montreal, where they are transferred to great ocean vessels.

However, the success of this great enterprise will not depend upon the local market. In selecting a site for an iron and steel industry, the first essential is cheap raw materials. The second is accessibility to the markets of the world. The shrewd business men who form the directorate of the Dominion Iron and Steel Company confidently believe that Sydney possesses greater advantages in these respects than any other locality in America.

The harbours of Sydney and Louisburg are the front doors of Canada. They might be called magic doors, for they open wonderfully into short passages to the leading markets of the world. It is an extraordinary fact that Sydney and Louisburg, while more than 2,200 miles nearer to Liverpool than New Orleans and Mobile, are at the same time nearly 600 miles nearer to Pernambuco, Rio Janeiro and Buenos Ayres, and nearly 900 miles nearer to Cape Town, South Africa. This is because ham-shaped South America lies far to the east of North America, while New Orleans, Mobile and other ports on the Gulf of Mexico are a long distance west of the Atlantic ocean. Moreover ships from Southern ports of the United States cannot take a direct route because they have to steer clear of the West India Islands. Cape Breton jutting far eastward into the Atlantic, is much nearer to a direct line drawn north from the east coast of South America. And the gulf ports are not the only ones over which the Cape Breton ports have an advantage. The whole Atlantic coast of the United States slopes away to the south west, and Savannah, Charleston, Baltimore, Philadelphia and New York are so far to the west of the direct routes from Sydney and Louisburg that the Cape Breton ports, although farther north, are much nearer to the chief ports of South America and Africa.

The most eastern point of South America is Pernambuco. All vessels going south of that point to Rio Janeiro, Buenos Ayres or other South American ports must pass it. The following tables of distances in nautical miles will show the wonderful advantage that Sydney has over all American ports for trading with Great Britain and other countries of Europe, South America, Africa, and Asia :

TO LIVERPOOL.

Sydney Harbour to Liverpool		Miles.
(via N. Ireland)		2,282
(via S. Ireland)		2,307
New Orleans	to Liverpool	4,553
Mobile	" "	4,506
Savannah	" "	3,571
Charleston	" "	3,500
Newport News	" "	3,157
Baltimore	" "	3,324
Philadelphia	" "	3,160
New York	" "	3,110

TO PERNAMBUCO.

	Miles.
Sydney Harbour to Pernambuco.....	3,567
New Orleans " "	4,146
Mobile " "	4,133
Savannah " "	3,660
Charleston " "	3,631
Newport News " "	3,591
Baltimore " "	3,758
Philadelphia " "	3,746
New York " "	3,696

TO CAPE TOWN.

	Miles.
Sydney Harbour to Cape Town.....	6,467
New Orleans " "	7,355
Mobile, Ala " "	7,309
Savannah " "	6,867
Charleston " "	6,831
Newport News " "	6,736
Baltimore " "	6,903
Philadelphia " "	6,870
New York " "	6,787

The distances from Sydney to the various points were furnished by Capt. W. H. Smith, R.N.R., Chairman Board of Examiners of Masters and Mates, Marine Department, Halifax, while the distances from various American ports were compiled by the United States Commissioner of Navigation. Louisburg is not given in the above tables, but the distances from Sydney and Louisburg are practically the same. Only points on the east coast of South America and the west coast of Africa are given for comparison, but it will be evident to all who examine the maps that Sydney must have the same advantage of distance in trading with the west coast of South America and the east coast of Africa. It applies also to the whole Pacific coast of North America, to Asia and Australia. It seems strange but it is a fact that Sydney is nearer to San Francisco than any Atlantic or gulf port of the United States. The distances given are for routes for full powered steamships.

Sydney Harbour is a magnificent one, in which all the fleets of the great powers might ride in safety without crowding one another. It is not only long and wide, but very deep. In the South Arm, which constitutes the port of Sydney, the general depth is from 42 to 54 feet, except close to the shore, and at the small wharf in front of the town of Sydney it is 30 feet deep. It is claimed that this harbour is more easy of entrance than any other in America, the mouth being wide and absolutely free from rocks and shoals. There are two bars, one on each side of the harbour at some distance from the mouth, which give absolute protection from ocean storms to the ports of Sydney and North

Sydney, but the water between them is wide and deep, and the soundings from the deep sea converge toward the inner harbour in such a way that mariners entering these ports can have absolute assurance that they are free from all dangers. Vessels passing out of the harbour enter at once into the open sea, and can go at full speed. The ocean routes from Sydney and Louisburg are well clear of Sable Island, and vessels making for these ports avoid all the dangers of that "graveyard of the Atlantic." The ferry boats on Sydney Harbour between the towns of Sydney and North Sydney usually run from the 20th of April to the 15th of January. The earliest closing in ten years was the 7th of January, and the latest the 4th of February. The earliest opening was the 3rd of April, and the latest the 1st of May. It would not be a difficult matter to keep the harbour itself open all winter, but ice sometimes blocks the gulf and Cabot strait. However, Mr. Reid's steamer Bruce, ran all last winter between Sydney Harbour and Newfoundland, and in view of the success of Russia in keeping up communication with its far northern ports by means of ships that break down ice twenty feet thick it is probable that communication between Sydney and Europe could easily be maintained throughout the year by keeping one such ship to break the way for other vessels. However, the harbour of Louisburg, which possesses all the advantages of Sydney as regards short distances from all the markets of the world, is open throughout the year. It is a beautiful harbour, although not as capacious as that of Sydney, and has a depth of from 54 to 66 feet. It is said to be the only port this side of the Atlantic where coal could be obtained at mine prices in winter. Louisburg is connected with Sydney by a railway about 40 miles in length, belonging to the Dominion Coal Company, and can be used by the Dominion Iron and Steel Company during the short period when Sydney Harbour is closed. For nine months of the year the route to Sydney is absolutely free from all dangers of ice, and it is claimed that its approaches are situated north of the large fog areas indicated on the "Pilot chart of the North Atlantic," so prevalent from the Grand Banks of Newfoundland to Sandy Hook, and sometimes westward to the Delaware.

Mr. George Dobson, secretary of the Sydney Harbour Board, recently published a pamphlet advocating that the fast Atlantic steamships on their way to Quebec or Montreal, in summer, should make North Sydney a port of call. He argued that the distance would be only 150 miles greater than by the Belle Isle route, and that as steamships could go at full speed all the way without fear of icebergs or fogs, better time could be made. Mails could be landed at North Sydney and forwarded by fast trains to the West. Sir Sanford Fleming is also an advocate of this route.

The advantages of Sydney as a coaling port are well known to seamen and many vessels trading between American ports and

Europe call there for coal. By doing so they are able to carry larger cargoes. In the year 1898 there entered Sydney Harbour, including the ports of Sydney and North Sydney, from the ocean 909 vessels besides 641 vessels engaged in the coasting trade. It may be noted that the number of vessels entering Montreal from the sea was 465 and those engaged in the coasting trade 3759. Being the nearest point to Europe and having a cable station, many vessels call at Sydney Harbour for orders which are cabled by their owners.

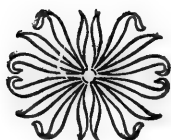
The works of the Dominion Iron and Steel Company will be located at this magnificent harbour of Sydney close to the town of Sydney and in the centre of one of the greatest coal fields in the world. On the other side of the harbour directly opposite the works are very large supplies of limestone. There are valuable deposits of magnetic iron ore a few miles away and numerous discoveries of other varieties of iron ore have been made in Cape Breton, but the Company own the most remarkable iron mine in the world on Great Bell Island, Newfoundland, and the ore can be mined and loaded on ships so cheaply that for the present the supplies of iron ore will be chiefly drawn from this source.

James M. Swank, secretary of the American Iron and Steel Association, says: "From the iron ore mines of Michigan and Minnesota to the coal of Pennsylvania the distance is 1000 miles. Connelsville coke is taken 600 miles to the blast furnaces of Chicago and 750 miles to the blast furnaces of St. Louis. The average distance over which all the domestic iron consumed in the blast furnaces of the United States is transported is not less than 400 miles, and the average distance over which the fuel which is used to smelt it is transported is not less than 200 miles."

The first furnaces in the Pittsburg district were started on local ores, but now almost the entire supply comes from the Lake Superior mines. The only blast furnaces of the United States that have their raw materials close together are in the Southern States. Of these the most favourably located are those of the Birmingham district in Alabama where fuel and ore are very close together. Moreover, the Alabama furnaces are far from the leading markets and the freight rates on the pig iron have to be added to the cost of production. The nearest seaport is Mobile, 276 miles by rail from Birmingham, the centre of the iron district. It is 349 miles by rail from Birmingham to New Orleans, 448 miles to Savannah, 476 miles to Charleston, 766 miles to Newport News, 804 miles to Baltimore, 855 miles to Philadelphia and 794 miles to Pittsburg. The freight from Birmingham to Mobile is one dollar per ton, to New Orleans \$1.40, to Savannah or Charleston \$1.75, to Cincinnati \$2.75, to St. Louis \$3.25, to Louisville, Ky., \$2.50, to Baltimore by the all rail route \$5.33, or by rail and water \$3.75, to Boston all rail \$5.83, or by rail and water \$4.10.

The iron ore of Pittsburg has to be brought from the mines of Northern Michigan and Minnesota by rail to a Lake Superior

port, and there loaded on vessels, after which it must be carried through Lake Superior, the Sault Canal, Lake Huron, Lake St. Clair, the tortuous channel of the Detroit River and Lake Erie to Cleveland and other Lake Erie ports, where it is transferred to railways to be transported to the furnaces. This makes three handlings of the ore between the Lake Superior mines and the furnaces as compared with one handling of the ore which will be used at Sydney. When the iron and steel is made Pittsburg is an excellent centre for distribution of the product in the central States, but it is a considerable distance from the seaboard and iron intended for shipment to foreign countries has to go by rail to Philadelphia 354 miles, to New York 445 miles, or to Boston 675 miles. The distance from Pittsburg to Montreal is 710 miles by rail as compared with the water route of about 726 miles from the works at Sydney to Montreal, but transportation is much cheaper by water than by rail.



The Strangest Iron Mine in the World.

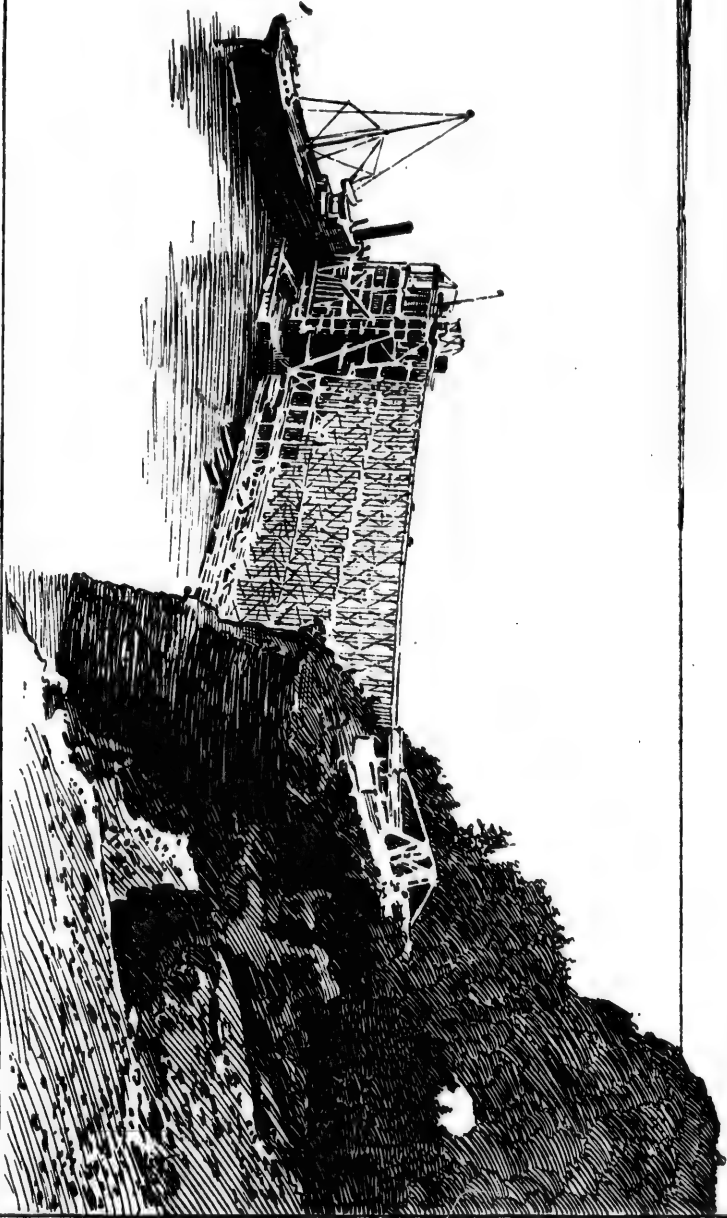
From the Montreal Daily Star, September 23, 1899.

II.

HE Wabana iron mine which was recently purchased by the Dominion Iron and Steel Company for a million dollars, is on Great Bell Island, in Conception Bay, Newfoundland, about 35 miles from St. John's. Experts pronounce it to be the most remarkable iron mine in the world, and even the ordinary tourist, who knows nothing about minerals, can appreciate its peculiar formation. The ore bed consists of small regular blocks of red hematite, most of them about four inches long, two inches wide and two inches thick, but some of them considerably larger. These blocks are piled one upon another and close together just as a child piles up wooden blocks, making a bed of ore of an average thickness of eight feet extending over 817 1-2 acres, which is estimated to contain over 28,000,000 tons of available ore besides the areas under the sea which will be referred to later on. The ore crops up at the surface and mining in the ordinary sense is not required. It is only necessary to shake the blocks of ore apart and they can be shovelled into cars without trouble. Indeed, as each of the little blocks of ore appears to be separate from the others, although they are piled very close together, it would probably be possible to pick them from the bed by hand, or knock them apart with a crow-bar, but this would be a tedious and expensive process and in order to loosen large quantities at once dynamite is used.

The Star is indebted to Mr. R. E. Chambers, M.E., manager at the mine, for most of the following information about the mine. There are in all five beds of ore exposed in the cliffs upon the northern side of Bell Island, but three of these extend over so small an area and are so thin that they are of little commercial value. The other two are known as the upper and lower beds, the former, which is estimated to contain six million tons, being still owned by the Nova Scotia Steel Company, which sold the lower bed containing 28,000,000 tons to the Dominion Iron and Steel Company. Both beds have the same peculiar formation. The outcrop of the lower bed is seen in the cliffs on the north side

WABANA PIER—GREAT BELL ISLAND IRON MINE.



of the island, its western extremity being at Ochre Cove and its eastern near Gull Island head. It extends for a distance of 3 1-2 miles without any apparent dislocation of the strata, and the ore is exposed over most of its extent, giving unusual facilities for open cut working. There is little doubt that 200 feet of this outcrop can be mined open cut over the greater part of this distance, giving about three million tons of ore, and when this is worked out many times that amount can be mined underground with natural drainage. When the 34,000,000 tons of ore available on the island are exhausted, which will not be for many years, the ore beds can be followed under the sea just as some of the coal mines in Cape Breton extend under the sea. Mr. Chambers thinks there is no doubt that enormous quantities of the ore could be obtained by following the ore bed under the sea.

The shipping facilities are excellent. Great Bell Island is eight miles long and two miles wide. The north side, where the ore is situated, is exposed to northern winds, but on the opposite side, where the shipping pier is located, there is a very good harbour, perfectly sheltered from the winds. The waters of the bay are deep and free from rocks and shoals; the bottom being mud near the pier affords admirable anchorage. Near the island the Admiralty charts show from 48 to 84 feet of water. The bay is navigable from eight to nine months of the year. The mine is connected with the pier by a double track cable tramway. This tramway is 2-foot gauge and two miles in length, and is operated by an endless steel cable 15-16 inch in diameter and four miles in length. There are 377 cars. It is an interesting sight to see the long rows of cars loaded with the little blocks of red ore moving towards the pier. The pier is 45 by 65 feet, and 90 feet high, constructed of Southern pine, which is supported upon 190 bearing piles surrounded by a crib-work of heavy timber filled with stone. There are ten pockets of 200 tons capacity each at a height sufficient to discharge into a steamer by gravity. The chutes for this purpose descend at an angle of 40 degrees and are moved by a counterbalanced winch, easily operated by one man. The cars are dumped by an automatic tipple, upset by the weight of the loaded car and returned to an upright position by cast iron counterbalance weights hung upon a shaft beneath the floor. In loading a steamer 200 tons have been discharged from one pocket in ten minutes. Two thousand five hundred tons a day can be shipped with the present facilities, and improvements can be made by the Dominion Iron and Steel Company to increase the output when required.

The depth of water at the pier is 24 feet at low tide, increasing rapidly away from the shore. The access is easy, unobstructed by rocks or shoals. The cost of mining ore and loading it on vessels is only from twenty-five to thirty cents a ton. The first shipment of ore was made in December, 1895, and since then about 600,000 tons have been shipped. This year 300,000 tons have been shipped. The terms of the Newfoundland mineral act

are very favourable to the operators in regard to security of title, the only condition being the expenditure of \$6000 for each square mile, no Government royalty being demanded. In this case the necessary expenditure has been largely exceeded in the equipment of the property by the Nova Scotia Steel Company.

The exact way in which the ore from this Newfoundland mine and coke made from Cape Breton coal will work together in the furnace is not a matter of conjecture. The Nova Scotia Steel Company has been using Cape Breton coke and Newfoundland ore together at Ferrona, with very great success for several years. The coal is carried from Cape Breton to Ferrona, where it is manufactured into coke. There are large coal mines in Pictou county, in the vicinity of Ferrona, and Pictou coke has been extensively used for smelting purposes, but large quantities of Cape Breton coke have also been used. The furnace at Ferrona is supposed to have a capacity of eighty tons a day, but it has been found that 110 tons a day can be made with Cape Breton coke and Newfoundland ore, as they work so easily together in the furnace. As already stated, each of the four furnaces at Sydney will have a capacity of 250 tons of pig iron per day, but in view of the experience at Ferrona, it is thought that this may be considerably exceeded.

At present the ore is being sent to the furnace of the Nova Scotia Steel Company at Ferrona, to Rotterdam, Holland, to Baltimore and other points in the United States, but when the Dominion Iron and Steel Company's furnaces at Sydney go into blast the ore will be reserved for their use. The four furnaces will turn out between three and four hundred thousand tons of pig iron annually and it takes less than two tons of iron ore to make a ton of pig iron, so that the 28,000,000 tons of ore in this mine would be sufficient to supply these furnaces for more than a quarter of a century without going beneath the sea. However, the Company will probably build other furnaces in a few years as the demand for their products increases.

But the Dominion Iron and Steel Company will not be entirely dependant upon this mine for supplies. There are many other deposits of iron ore in Newfoundland, situated near to the sea, and, while it is not probable that any of them can be mined so cheaply as the peculiar ore beds of Great Bell Island, they will no doubt compare favourably with mines in other places. Then the Company also owns a valuable iron mine in the Santiago district of Cuba, and ore from this mine can be brought to Louisburg at all seasons of the year. There are iron ore deposits in almost every section of Nova Scotia and New Brunswick and some of them are of superior quality. Any one who has read the Government geological reports and the writings of Sir William Dawson and other scientists who have studied the geology of the Maritime Provinces must be impressed with the widespread indications of iron in these Provinces.

Nothing else has contributed so much to the cheapening of iron ore in the West as the increased size of the vessels that navigate the upper lakes. It is a well known fact that the larger the cargo a ship can take the cheaper freight rates will be. But there is a limit to the size of boats that can go through the Sault canals and get into the lake ports. The Sault canals would have to be greatly enlarged and the lake harbours would have to be deepened at enormous expense before boats drawing twenty-four feet of water, such as can reach the pier at Great Bell Island at low tide, could be accommodated. And most of the harbours in the Maritime Provinces are deeper than that at Great Bell Island. Indeed these Provinces abound in magnificent harbours capable of accommodating not only the largest ships now on the ocean, but much bigger ships than any yet built.

Ore from the Lake Superior mines can only be shipped by water for about seven months of the year, lake navigation being closed during the winter. There are thirteen harbours in New Brunswick and Nova Scotia open throughout the year, viz., St. John and St. Andrews in New Brunswick and Halifax, Louisburg, Yarmouth, Annapolis, Barrington, Liverpool, Lockport, Lunenburg, Parrsboro and Shelbourne in Nova Scotia, besides a host of good harbours which are open nine months of the year. The iron ores in every section of the Maritime Provinces are within easy reach of seaports and could be transported to Sydney or Louisburg at all season of the year. Valuable iron ores have been found in various sections of Quebec province, and ores from all parts of Quebec province could be cheaply shipped to Sydney, during the summer. But Cape Breton itself appears to be well supplied with iron ores according to the reports of the Government geologists.

In making iron it is often advantageous to mix different ores together to get various qualities of iron. The wonderful geographical position of Sydney and Louisburg, with their deep water harbours, nearer to all quarters of the world than any other seaports of the American continent, will give the Dominion Iron and Steel Company a very great advantage in bringing ore from any outside point for such intermixture.

Value of the Great Bell Island Mine.

From the Montreal Daily Star, September 27, 1899.

III.

IN preceding articles of this series it has been shown that Pittsburg, the leading iron-making centre of the United States, gets nearly all its iron ore from the mines south of Lake Superior, and that the ore has to be carried first by rail, then by water, and again by rail for about a thousand miles, involving three handlings, before it reaches the blast furnaces, while the ore to be used by the Dominion Iron and Steel Company in the blast furnaces at Sydney will come from the Great Bell Island mine in Conception Bay, Newfoundland, about 400 miles distant from Sydney, and will only have to be handled once, being loaded at the mine upon large ships that will lay it down at the pier of the Company right beside the blast furnaces.

It has been stated that the ore of Great Bell Island can be mined and loaded on ships for from twenty-five to thirty cents per ton. This is not a matter of conjecture, but of actual experience extending over several years in which 600,000 tons of ore have been mined and shipped. No royalty has to be paid. Some idea of the freight rate from Great Bell Island to Sydney can be obtained from the freight rates on the ores shipped from Lake Superior ports to Ohio ports, a much longer distance. The average rate during 1898 on iron ore shipped from Escanaba to Ohio ports was 50.8c; from Marquette to Ohio ports, 59.8c; head of Lake Superior to Ohio ports, 61c. The average rate during the past ten years has been: From Escanaba, 67c; from Marquette, 83c; from the head of Lake Superior, 94c. During recent years the rates have been lowered owing to the increased size of the boats navigating the Upper Lakes. Most of the ore from Lake Superior was brought down to Lake Erie ports last year in the large 6000-ton ships which were put in commission in 1897. It was found that the smaller boats could not compete with them.

The distance from Great Bell Island to Sydney being much shorter and through much deeper waters without any canals to go through, or any tortuous, narrow channels to navigate, larger cargoes could be carried and better time could be made, so that the freight rate on ore should be lower. It may, therefore, be assumed that the cost of laying down ore at the Sydney blast furnaces, including mining, loading, shipping and unloading, will not exceed one dollar per ton, and it may be considerably less. Let us compare this with the cost of ore in other places. At Cleveland, Ohio, according to The Mineral Industry, the prices fixed last year by the agents handling ores were as follows: Hematite ores, Bessemer quality, \$2.55 to \$3.25; hematite ores, non-Bessemer quality, \$2.10 to \$2.25. The annual statistical report of the American Iron and Steel Association gives the prices at which sales were made early in 1899, for season delivery at Cleveland, as follows: No. 1 Bessemer hematites, \$2.80 to \$3.25; soft hematites, No. 1, non-Bessemer, \$2.00 to \$2.15. From Cleveland to Pittsburg the iron ore has to be carried by rail and the freight rate on ore must be added.

The Stateman's Year Book, says that in the year 1897 the United Kingdom imported 5,968,680 tons of iron ore, the value of which was £4,436,004, that is, 14s. 10d. per ton, equal to about \$3.60 per ton, in Canadian money. From 1893 to 1897 inclusive, 24,336,814 tons were imported, and the value was £16,963,370, that is, 14s. per ton, equal to about \$3.40 per ton in Canadian money. At the present time Spanish hematite ores laid down in Glasgow are selling at 15s. to 17s. per ton, that is, from \$3.65 to \$4.15 per ton. "The Iron and Coal Trades Review," published in London, Eng., in its issue of September 1, 1899, states that the price of hematite ore at the mines on the west coast of England on August 31 was 16s. equal to \$3.90.

The Nova Scotia Steel Company has been selling Great Bell Island ore in Rotterdam at a price which amounted to \$1.15 per ton at the mine, after deducting the cost of transportation, giving them a profit of 85 or 90 cents per ton, and we understand that the Dominion Iron and Steel Company have assurances that they can sell ore in Rotterdam for delivery next year at from 15 to 16 marks per ton, which would give them from \$1.65 to \$1.90 at the mine, after paying the cost of mining and transportation, making the profit on every ton of ore mined for export from \$1.35 to \$1.60.

The iron ore supplies of Great Britain, Germany and other iron manufacturing countries of Europe are rapidly becoming exhausted. Great Britain has for years been drawing supplies from Spain and other outside countries. The making of iron is not a new thing. In the 4th chapter of Genesis Tubal-cain is described as an "instructor of every artificer in brass and iron," and nearly all the ancient writers refer to the use of iron. In all the ages that have passed since Tubal-cain first began to work

in metals, iron has been used in various industries, and when we consider how many millions of men have lived and died since then, it is not at all surprising that the supplies of iron ore in the old world are running out. Great Britain has been making enormous quantities of iron for generations, and great as are the natural resources of those little islands, the supplies of the raw materials cannot hold out much longer at the present rate of consumption. Long before the mines of Europe are completely exhausted the scarcity of ore is likely to enhance the price.

According to Mr. R. P. Rothwell, a well-known American authority on iron, the production of pig-iron in the iron-making countries of the world in 1898 required the mining and handling of approximately 70,000,000 tons of ore. The United States alone consumed 21,772,750 tons of iron ore in 1898, of which 14,029,683 tons were mined in the Lake Superior district, 4,980,000 tons in the Southern States and 1,678,500 tons in other states. Besides this home production of iron ores 187,219 tons were imported into the United States from abroad as compared with 489,970 tons imported during the preceding year, the decrease in imports being largely due to the war with Spain. The great iron manufacturers of the United States are growing alarmed lest their supplies of ore should run short and have been buying up iron mines. In Great Britain it is estimated that 14,000,000 tons of ore were mined and 5,468,395 tons imported last year. In Germany 15,893,246 metric tons of ore were mined.

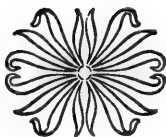
The London Economist recently discussing the probability of Great Britain losing its supremacy in the manufacture of iron and steel, said: "It must be remembered for how long a period the mines in this country have been worked. The output of blackband ore in Scotland has been decreasing for years past, and the greater portion of the pig-iron now made in that district is from foreign ores. Cleveland which has been one of the most prolific districts in the country, has now been worked nearly fifty years, and the best ore having been taken out first, we may soon have to fall back on the poorer, and consequently costlier kinds. It has been known for some time past that the best hematite ores in the Bilbao district in northern Spain are fast deteriorating, and if we have to fall back on the poorer qualities, those containing a lower percentage of iron, they will be more costly, owing to the proportionately greater cost of carriage by sea."

In another issue the Economist says: "As the production of Great Britain cannot very readily be extended, owing to the difficulty of obtaining ore, it seems probable that the United States will have to supply the bulk of the additional three million tons of pig-iron which are likely to be required during the next three years."

It has been thought that the Lake Superior mines were inexhaustible, but before the boom of this year it was considered a

most significant fact that some of the most experienced American companies were quietly buying ore mines, which two or three years previously were closed down, because their ores were unsaleable in competition with the best ores of Lake Superior.

Taking into consideration the increasing demand for iron ore and the fact that the supplies are becoming exhausted in many sections where they were formerly plentiful, it is evident that the Dominion Iron and Steel Company might make a great deal of money by simply exporting iron ore from their wonderful Newfoundland mine, but there is more money to be made in converting the ore into pig-iron and steel, and it will be far better for Canada, as thousands of men will be employed in the coal mines, coke ovens, blast furnaces and steel mills of Sydney, and the industries that will grow up around them.



Cheap Coke for The Sydney Furnaces.

From the Montreal Daily Star, September 30, 1899.

IV.

N selecting a site for blast furnaces it is always considered desirable to get as near to coal mines as possible. The iron ore is usually carried a long distance, but furnaces that have to bring their fuel from a distance are at a great disadvantage. It is much more economical to carry the iron ore to the coal than the coal to the ore. It is true that some of the furnaces in the United States bring both their ore and their fuel from a distance, the Chicago blast furnaces, for example, getting their coke from Connellsville, Pa., and their iron ore from the Lake Superior mines, but iron can be manufactured much more cheaply when the furnaces and the coke ovens are close to the coal mines. The Dominion Iron and Steel Company are particularly fortunate in having secured a site for their works in the centre of one of the greatest coal fields of the world. The Sydney coal field occupies an area of about 200 square miles, and has productive coal measures exceeding 6,000 feet in thickness.

It is one thing to have coal, and another thing to have coal suitable for fuel in making iron, but there is no doubt that at least four of the mines owned by the Dominion Coal Company within a short distance of the blast furnaces now being constructed by the Dominion Iron and Steel Company, produce coal which makes coke exceedingly well adapted for the blast furnace. This has been shown not only by an analysis of the coal, but also by using the coke extensively in the blast furnace at Ferrona, with Great Bell Island ore, for several years.

The Dominion Iron and Steel Company have made most favourable arrangements with the Dominion Coal Company for securing any quantity of coal that may be desired at a very satisfactory price. Mr. Henry M. Whitney is president of both companies, and until January, 1903, the Iron and Steel Company will have the option of leasing the Dominion Coal Company,

including all its mines and the Sydney and Louisburg Railway, for ninety-nine years, on condition of paying the fixed charges, and six per cent. annually on common stock. Whether the directorate of the Iron and Steel Company decide to lease the Coal Company or not, the contract between the two companies permanently assures to the Iron and Steel Co. an ample supply of cheap fuel.

The coal of Cape Breton is bituminous. The different fuels used in blast furnaces are charcoal, anthracite coal and coke from bituminous coal. Charcoal is an expensive fuel, and while it makes a superior iron, it is usually too costly to be used for ordinary purposes. At one time all iron was made with charcoal as fuel, and there is still a considerable demand for charcoal iron for making car wheels and some other purposes. It is also used to a certain extent for admixture with iron made with anthracite or coke as fuel. But the cost of iron and steel for ordinary purposes has been greatly reduced by the use of coal and coke.

Bituminous coal contains much more volatile matter than anthracite, and it is, therefore, unsuitable for the blast furnace until the volatile constituents are taken out of it, when it is called coke. Dr. Joseph D. Weeks, of Pittsburg, editor of the *American Manufacturer and Iron World*, who has made a study of coke and coking for years and is regarded as one of the best authorities in the United States on this subject, has described the difference between anthracite coal and coke and the process of coking most lucidly. He says: "Anthracite coal is solid, while coke is porous, being filled with little cells. It is this porosity, this cell space, that makes coke a more vigorous fuel than anthracite, that is, it will burn more rapidly, just the same as a pound of shavings will burn more rapidly than a pound of solid wood. There is the same amount of heat in the same weight of each, but the one burns much more freely, much more rapidly, is a much more vigorous fuel. It is this porosity of coke combined with its toughness and hardness that in a large measure gives it value as a blast furnace fuel much superior to anthracite. A modern blast furnace, say 18 feet in diameter at the boshes, using anthracite coal will do good work if it makes 400 tons a week. A furnace of the same size using coke will make four times this amount; and a furnace is being built at Pittsburg to use coke as fuel that will make at least 500 tons a day, a feat that would be utterly impossible with anthracite as fuel. In our United States practice the value of a blast furnace fuel depends largely upon the rapidity with which it will do its work. It is the same in many operations. We must do our work quickly, and to do this where heat is used, we need a quick-acting, vigorous fuel. This gives a porous fuel like coke its great value. I could make a fuel in a coke oven very like anthracite, provided I did my coking under pressure, but I would destroy one of the most valuable features of the coke as fuel, its porosity.

"Coking is simply the driving off from bituminous coals, by the action of heat, of the volatile matter they contain. No matter how coking is performed, whether it be in an illuminating gas works or in a bee-hive or a by-product coke oven, what takes place is always the same. As the heat is applied the coal begins to swell, becomes pasty and sticky and throws off bubbles of gas. In a word, the coal melts, loses all traces not only of its original form, but of its appearance and structure as well, and the particles freed from volatile substances unite in a coherent mass or as it is termed 'cake,' or 'coke.' As this melted coal solidifies or 'cakes,' it encloses small bubbles of gas, which make the cells like those in a piece of blast furnace coke if the 'gassing' process has not been pushed too rapidly. But these pores, these cells, can be made large or small. If the operation is in a small body of coal and the 'gassing' is pushed, you get the weak coke with large cells, known as gas-house coke, that will hardly bear its own weight. But if the coking is done under proper conditions, you get a hard, strong coke that will bear the burden of the blast furnace."

It is evident from the above that bituminous coal when properly coked makes the best fuel for a blast furnace. The Dominion Iron and Steel Company have already given out the contracts for the construction of 400 Otto-Hoffman by-product coke ovens, which will be located between the iron works and the coal mines, in the most convenient situation that could be desired. These coke ovens, which will cost about \$1,250,000, will be of the most modern design, and will save all the by-products of coal which are allowed to go to waste at nearly all the coke ovens and blast furnaces in the United States.

The coke-ovens in general use in the United States are known as bee-hive ovens, because they are dome-shaped. The sole object aimed at in these ovens is to make coke, all the valuable volatile constituents of the coal being lost. A lump of bituminous coal is a storehouse in which a great variety of valuable chemicals are locked up. The bee-hive oven sets them free, or destroys them, and only saves one thing—the coke. The by-product coke-ovens, which are now universally used in Germany, which are rapidly displacing the bee-hive ovens in England and Scotland, and are beginning to come into use in the United States, are designed to save everything in the coal and make practical use of all its constituents.

Dr. Weeks has given the following description of the two kinds of ovens: "The bee-hive oven, which takes its name from its shape, is usually in the Connellsville region of Pennsylvania, 12 feet in diameter, by 7 feet high, with two openings, one in the top, through which the coal is charged into the oven and through which the burning gases and waste products of combustion escape into the air; and the larger opening or door in the front, through which the air is admitted for combustion, and out of which the

coke, after being burned and quenched, is drawn. Air is admitted in this oven above the coal during the process of coking ; the heat necessary for coking being derived partly from the heat stored in the walls of the oven during the coking of the furnace charge, but chiefly from the combustion in the oven of the gases and a part of the coal. It requires 48 hours to coke a charge of 5 tons of coal. The by-product oven, on the other hand is a closed oven. No air is admitted into that portion of the oven in which the coal is being coked. Consequently no combustion takes place in the oven. The heat necessary for coking comes from the combustion of gas and air in flues in the side walls and the bottom of the oven, the heat passing through the fire brick walls which separate these flues from the coking chamber or oven proper. The by-product oven is a long narrow oven, the coking chamber of which is from 25 to 33 feet long, 14 to 28 inches wide, and 5 1-2 to 7 feet high. It is charged through two or more charging holes in the top ; the weight of the charge being 5 to 8 net tons of coal. The time of coking is from 18 to 48 hours. The products that pass off are just as they come from the coal. There is no air mixed with them at all, as there is in the bee-hive oven. There is no waste of the carbon in the coal. It is not so in the bee-hive oven. You burn a part of the coal in the bee-hive oven in the process of coking the rest. The advantage of coking without the admission of air is in the first place that the total amount of carbon, which is in the coal, is saved in the coke ; in the second place, a different kind of tar and gas is produced from what would be formed in an open bee-hive oven ; and in the third place, the action of the ovens can be perfectly controlled, of course within limits, but the limits are very broad. As to the by-products or those products that go off with the volatile matter, the chief of these are ammonia, which can be procured either as ammoniacal liquor aqua ammonia or sulphate of ammonia ; tar, which is practically the same as the coal tar of the illuminating gas works, making gas from coal ; and gas which differs but little from illuminating gas.

“ One word only about the method of collecting these by-products. Running along the top of the bank or block of by-product ovens is a large pipe into which the gas evolved in coking passes. All the gas from all the ovens passes into this one pipe, the result being that a gas of quite uniform composition is produced. As it passes along the tar is condensed just as it is at an illuminating gas works. The gas freed of its tar passes through the ammonia scrubber in which the ammonia is taken out of it precisely as it is in an ordinary gas works, only on a much larger scale. The gas is then either purified and enriched if necessary, and used for illuminating or heating purposes or it can be returned to the ovens and burned in the flues for coking the coal. In the latter case there is more gas than is necessary

for coking, giving several thousand feet of tar gas, as it is called, as well as a large amount of waste heat."

Dr. Weeks was sent by the United States Government to England, Germany, France and Belgium to examine the coke ovens there, and he has no hesitation in saying that the by-product coke ovens make better coke for metallurgical purposes than the bee-hive ovens. He says: "The Germans, with by-product coke, and with an ore greatly inferior to that we use in our blast furnaces, are doing better work than we are. They are using fewer pounds of coke to produce a ton of pig-iron with poorer ore and by-product coke, than we are on the average with our rich Lake Superior ores and our Connellsville bee-hive coke. These by-product ovens are no experiment. There are some 4,000 of them in operation in Europe to-day. The only reason why the number of such ovens has not vastly increased is that the amount of capital invested in ovens already erected in old coke making sections is so large that the owners hesitate to throw it away. There are 45,000 ovens of the bee-hive pattern in the United States. It would be a low calculation to say that they cost \$400 apiece. That is \$18,000,000. One will hesitate a good while before throwing away this amount of money. But as new ovens are erected abroad, by-product ovens are being built, and this will be true of the United States also."

The Dominion Iron and Steel Company, starting with everything new, are fortunately not obliged to maintain antiquated coke ovens. But they will not have to make any experiments. The Otto-Hoffman ovens are in use everywhere in Germany, several plants are in successful operation in the United States, and the New England Gas and Coke Company, organized by Mr. Henry M. Whitney to provide a market for Cape Breton coal, have just constructed 400 of these ovens at Everett, a suburb of Boston, so that the Dominion Iron and Steel Company will have the advantage of their experience. The coke made at Everett is sold to the railways and for domestic or industrial fuel purposes, while the gas is used to supply Boston and its suburbs with light and heat and for gas engines. At Sydney the surplus gas will be used in the steel mill.

As no part of the coal is consumed in the process of manufacturing coke with the Otto-Hoffman coke oven the output of coke is about 15 per cent. greater than from the bee-hive oven with the same quantity of coal, but the chief advantage is in the saving of the by-products, gas, ammonia and tar, which more than pay the cost of turning the coal into coke.

With most of the uses of liquid ammonia the readers of The Star are well acquainted, but very few appreciate the value of sulphate of ammonia as a fertilizer. The chief constituent of ammonia is nitrogen; and as everybody knows nitrogen is the fertilizer most required to make soils productive.

In the course of a most interesting address advocating the establishment of by-product coke ovens in the vicinity of Boston before a Committee of the Massachusetts State Legislature, Mr. Henry M. Whitney said :

"Everybody who is familiar with agriculture knows that the three essential elements of plant food are nitrogen, phosphoric acid and potash. Now, we have, fortunately for this state, an agricultural experiment station at Amherst which keeps in close touch with the value of commercial fertilizers, of which the land of this state and of New England is in such great need. A few days ago I visited Amherst, and spent an evening with Prof. Goessman, who has charge of this station. I felt certain that while the theoretical value of barn-yard manures was a certain quantity, yet that there was a certain amount of waste from the time that it was dropped until it reached the field, and I was anxious to find out what proportion of the theoretical whole was preserved. I found that the experiment station had made tests [66, I think, in all] of manures in various parts of this state to determine exactly what the manurial value in nitrogen, potash and phosphorus is as it is put on the ground. These are Prof. Goessmann's conclusions :

Nitrogen, 4-10 of 1 per cent. equals 8 lbs., at 12c per lb ; total value	.96
Phosphoric acid, 2-10 of 1 per cent., or 4 lbs., at 5c per lb. ; total value ..	.20
Potash, 3-10 of 1 per cent., or 6 lbs., at 4½c per lb. ; total value	.27
Total value of one ton manure.....	\$1.43

Therefore if you were to buy commercial fertilizers containing the same amount of plant food that is found in a ton of manure, you would pay for it \$1.43. I do not undertake to say, Mr. Chairman and Gentlemen, that there are not some other elements in the manure that are of value to the soil, but I do undertake to say that, so far as the experiments of the agricultural station made with exceeding care have gone, you can purchase with \$1.43 the same amount of nitrogen and potash and phosphoric acid as you will find in a ton of manure.

"In every ton of bituminous coal burned to-day there is the equivalent of 25 pounds of ammonia, which is the equivalent of 5 pounds of nitrogen, and at the same value at which it is reckoned here as manure, there is a money value of 60 cents. The waste of fertilizer in every six tons of bituminous coal which is burned throughout New England, is equivalent to the manurial value of an animal for a year. Now, what does it mean with reference to the agricultural industry of Massachusetts, if all this nitrogen could be saved and placed upon your soil? It means that in the 6,000,000 tons of coal that are burned throughout New England to-day there is a manurial value of a million of cattle. I know of nothing more hopeful for the agriculture of this state nor of New England, nor of the whole of this broad land, than that capitalists are turning their attention to-day to the preservation

of this great amount of nitrogen which is needed for your exhausted soils."

It would be interesting to speculate upon the effect that the saving of the nitrogen in the coal of Cape Breton may have upon the agricultural future of the island. Cape Breton is green above although black beneath. Its coasts do not present the rugged appearance of the mainland of Nova Scotia. It is a hilly country, but the hills are neither high nor abrupt. Most of them look as if they might be cultivated from top to bottom, and some of them are. A Star man asked Mr. Hiram Donkin, resident manager of the Dominion Coal Company at Glace Bay, C. B., if much of the island could be successfully cultivated.

"There are some excellent agricultural and pastoral districts," said Mr. Donkin, "but in the coal districts the soil lacks one important constituent. The coal seems to have robbed it of its nitrogen, but Mr. Whitney proposes to take the nitrogen from the coal in his coke ovens and restore it to the soil. That is all that is required to make it fertile."

But Cape Breton will not be the sole market for the sulphate of ammonia produced at the coke ovens of the Dominion Iron and Steel Company. There should be a demand for it from farmers in all parts of the Dominion to improve soils that have been worn out, and no doubt the whole output could be sold in Great Britain, where there is a brisk demand for it. A great deal of the sulphate of ammonia produced at the coke ovens of Germany is utilized by the farmers who grow beets for the sugar factories, and the rapid development of beet sugar manufacture in the United States is likely to create a demand for it in that country. Sir William Crooks, the well-known British scientist, recently predicted that unless some new sources of nitrogen should be discovered there would be a wheat famine in a few years, as most of the wheat areas of the world are rapidly having their nitrogen exhausted by continuously growing wheat. At Everett, the New England Gas and Coke Company sell their sulphate of ammonia for 2 1-2 cents per pound, and get about 30 lbs. from a ton of Cape Breton coal in the process of coking. Assuming that only 28 lbs. of sulphate of ammonia will be obtained at Sydney, and that the selling price will be only 1 3-4 cts. instead of 2 1-2 cents it will give 49 cents per ton of coal. The by-product ovens at Everett also obtain from a ton of Cape Breton coal about 12 1-2 gallons of tar which is sold at 2 cents per gallon, and about 5,000 feet of gas which is sold at twenty cents per thousand. At Sydney the surplus gas will be used in the steel mill and it will be fair to estimate its value at the cost of natural gas in the most prolific natural gas districts of the United States, five cents per thousand. This will give the steel mill as cheap fuel as if it were located in a natural gas district. It is calculated that the quantity of gas produced at Sydney will be somewhat less than at Everett as the coke will be treated

somewhat differently to suit the blast furnaces, but it will not be less than 3,000 feet, which at five cents per thousand would be fifteen cents per ton of coal. The quantity of tar obtained will be about ten gallons, which at one cent per gallon, half the price obtained in Boston, would give ten cents. Thus the value of the ammonia, gas and tar obtained from each ton of coal will be not less than 74 cents, while the cost of manufacturing the coke and by-products will only be about 40 cents. This will bring down the cost of fuel for the blast furnaces to a very low figure.

It may be said, "If a lump of coal is a storehouse for a great variety of chemicals, as stated, why only mention gas, ammonia and tar? What becomes of the other volatile constituents of bituminous coal?" The answer is that many of the constituents of coal are preserved in the tar. Coal-tar is, as described by Dr. Lunge, "an extremely complex mixture of chemical compounds." Dr. Lunge, in his work on Coal-Tar and Ammonia, gives an enumeration of the constituents of coal-tar which fills three and a half large pages, and it would occupy fully a column of the Star. One of the most interesting constituents is aniline-benzol, which is used for making aniline dyes. There are a great many chemical works in Germany which utilize the tar produced at the by-product coke ovens in connection with blast furnaces. It is not improbable that enterprising capitalists may select Sydney as a site for a tar distillery and chemical works, thus giving Canada another industry. The location would be most advantageous, not only on account of the cheapness of the tar, but also on account of Sydney's nearness to all the important markets of the world. But even without distilling, coal-tar is of value for many purposes. It is used very extensively for the preservation of building materials of all kinds. Stones, as well as iron and wood, can be preserved much longer and protected against atmospheric influences, by a coating of coal-tar. It is also used in the manufacture of roofing felt, and in making lamp-black, while owing to its antiseptic property it is often used in England for painting the floors of hospitals and barracks.

The President and Directors.

From the Montreal Daily Star, October 14, 1899.

V.

ANADA is about to enter upon an industrial contest with the leading nations of the world in exporting iron and steel, and it is a matter for congratulation that we can truthfully say,

"We have the ore, we have the fuel, we have the flux, we have the men, we have the money too."

It has been shown that the Dominion Iron and Steel Co. will have ample supplies of cheap ore and cheap fuel of the best quality for their blast furnaces at Sydney, and it may be noted that on the other side of Sydney harbour, directly opposite the works, there are extensive beds of limestone which can be used for flux. And the men! In making iron and steel, good workmen are as important as good and cheap raw material. A great deal depends upon the intelligence, sobriety and health of the workmen, and one of the many factors likely to contribute to the success of the Dominion Iron and Steel Company is the character of the people of the Maritime Provinces of Canada. The writer of these articles has visited every section of those provinces, and everywhere he found bright, intelligent, sturdy, healthy-looking people, temperate in their habits, honest, reliable, and quick to understand. In the past the supply of labour has much exceeded the demand, and thousands have emigrated to the United States. Many of the best workmen in the cities of New England were born in the Maritime Provinces. There will be no difficulty in securing good workmen for the blast furnaces, steel mills and other industries of Sydney.

But much also depends upon the character of the men at the head of the enterprise. What manner of men are the capitalists who have paid a million dollars for an iron mine and who are expending many millions of dollars in constructing iron and steel works on a scale that will enable them to compete with the

largest iron and steel industries of the world? Are they men who are likely to fail to take advantage of the favourable conditions that have been described? No one who has read the names of the president and directors will have much doubt upon this point. All of them are well known as very successful business men; most of them have the reputation of being gifted with what is called "the golden touch," because everything they handle seems to turn into money; and some of them have already a world-wide reputation on account of the great enterprises in which they have taken a prominent part.

The moving spirit in the enterprise, the man who will devote most capital, time and energy to ensure the success of the undertaking is Mr. Henry M. Whitney, President of the Dominion Iron and Steel Company. Mr. Whitney was born in the town of Conway, Mass., October 22, 1839. His father, Gen. James S. Whitney, afterwards collector of the port of Boston, kept at that time the principal store of the place, and it was there and subsequently in the Conway bank that he began his business life, after obtaining his education in the local schools and at the Williston Seminary. The removal of his father's family to Boston carried him with it, and for several years he was employed, first in the Custom House, then in one of the Boston banks, and subsequently in the shipping business in New York City. In 1886, he became under his father, who was president of the corporation, the agent of the Metropolitan Steamship Company, having a line of freight steamers plying between Boston and New York, an office which he has continued to hold up to the present time.

In 1879, on the death of his father, he became president of the company, and in the management of its affairs he exhibited for the first time in a broad and striking manner the indomitable energy and resourcefulness of mind that have been characteristic of so many of his subsequent business enterprises.

He had been for several years a large operator in real estate; but in 1886 he conceived the idea, that if a broad boulevard were built out from Boston, through its most attractive suburb, the town of Brookline, and a superior system of street car service were provided, the result could not fail to be advantageous to the community and beneficial to the promoter. Acting on this belief, first by himself and afterwards in conjunction with others, he acquired such land on the line of the proposed route as could be obtained, and then agreed to build the boulevard himself, contributing one-third of the cost, if the town of Brookline would pay the other two-thirds. This offer was accepted, and the construction of the boulevard, one of the most attractive thoroughfares in America, was entered upon. But before it was completed Mr. Whitney discovered that the street railway companies of Boston would not permit the cars of his projected new line to carry their passengers into the centre of the city, thus threatening to seriously diminish the utility of his proposed plan. A man of less determination of

character and originality of mind would have been thwarted by this stubborn resistance of strong vested interests. But with him opposition was only an incentive to greater exertion and more comprehensive action. His method of releasing himself from a seemingly inextricable entanglement was startling in its boldness. It was to use the little West End Street Railway Company that he had organized as a medium for absorbing and uniting into one harmonious corporation all of the different and often conflicting street railway companies of Boston. The obstacles in the way were innumerable. City and State Governments, railroad commissioners, obstinate and jealous railroad officials and unwilling stockholders, all had to be considered and treated with. But the courage which planned was backed by the tact, good judgment, persuasiveness and energy needed to carry the project through to a successful conclusion. To secure the needed financial results, he had foreseen and counted upon the general introduction of electricity as a motive power, and hence when made president of the enlarged West End Company he almost immediately began the application and utilization of this new form of motive power. The West End Company was the first of the street railway companies to adopt the electric system on an extensive scale. It was the pioneer and all the other street railways of the continent have followed its example. The outcome has been the building up of a system of rapid street transportation in and around Boston, which in range and character of service is without a rival in the world.

The next large business operation into which Mr. Whitney entered was the formation of the Dominion Coal Company. Having had his attention called to the existence in the Sydney district, Cape Breton Island, of a number of independent coal mines operated in the expensive, old-fashioned manner of coal mining, he convinced himself, after investigation, that it would be possible by uniting these small companies into one large corporation, to profitably introduce improved labour-saving mining machinery, and in this way not only materially reduce the cost of mining, but greatly increase the output of the mines.

By equipping the mines with the most modern machinery, connecting them by railway with great shipping piers, which he had constructed at Sydney and Louisburg, reorganizing the transportation service between Sydney and Montreal, and providing facilities for rapidly unloading the coal at this port, the cost of mining and marketing the coal was greatly reduced. The Canadian demand for coal was steadily increasing, but the coal areas owned by the Dominion Coal Company being extensive and the seams very thick, Mr. Whitney realized that the industry was capable of immense expansion if an adequate market could be secured. He had from the first had in mind the possibility of securing a large market for Cape Breton coal in New England, but he met with unexpected difficulties. He was dis-

appointed in his hope of securing the abolition of the American customs duty on coal, and moreover, he found that Cape Breton coal was not so popular in New England as some of the American coals with which it had to compete, because it was more smoky. It is a characteristic of Mr. Whitney that he often makes what at first seems an insurmountable difficulty a stepping stone to great success, and here again his business genius asserted itself. Failure or half-success is a conclusion which he will never accept as final. An outlet to the West End problem had been discovered through a practical, but imaginative, foresight of the revolution in transportation which was to be brought about by the utilization of electricity. The Dominion coal problem found an equally brilliant solution by a mental forecast which convinced him that a large part of the use of bituminous coal in the future was to be found in the separation and independent employment of its constituent parts. He knew that the smokiness of bituminous coal was due to the fact that its volatile constituents passed off in burning. He knew that these constituents, the gas, ammonia and tar, were valuable for many purposes, and he reasoned that if instead of being allowed to go to waste they were taken from the coal before it was sold they might be profitably utilized, while a more satisfactory fuel could be offered to the public.

With Mr. Whitney investigation quickly succeeds conception, and positive action follows hard upon satisfactory investigation. His first step was to organize the Massachusetts Pipe Line Gas Company, by means of which the gas obtained by treating the slack or culm of the Dominion Coal Company could be sold to the various Boston Gas Companies at a price which would compel its purchase. Following this came the tests of the coke, made by some of the leading railway companies, as a means of demonstrating its utility and advantage for locomotive steaming purposes. The results of these tests were all that could be desired, and the railway companies were so pleased with the result that they offered to pay a higher price for it than for coal, as it gave them a clean fuel, free from smoke and cinders, possessing all the advantages and none of the disadvantages of coal for steam purposes.

Next came the organization of the New England Gas and Coke Company for the purpose of building coke ovens on a large scale on the water front near Boston, in which the culm could be treated so as to release and separate its constituent parts, the company at the same time acquiring control of the Massachusetts Pipe Line, of certain of the gas companies in and around Boston, and a contingent interest in other gas plants. This organization has now nearly completed its works, and in a short time will use many hundreds of thousands of tons a year of coal of the Dominion Coal Company in supplying Boston and its vicinity with low-priced gas, and in furnishing the railroads which have their

terminals there and neighbouring manufacturing establishments with the coke they need for fuel. A number of the by-product coke ovens are already in operation and the coke has become very popular as a domestic fuel, as well as for use on the railways and in industrial establishments, while there is no difficulty in disposing of the tar and sulphate of ammonia at prices which more than pay the cost of manufacturing both coke and by-products and the customs duty on the slack coal that is used.

The idea of establishing iron and steel works on a large scale at Sydney, near the mines, at tidewater, and within easy reach of the immense iron ore deposits of Newfoundland, as a means of creating an extra demand for the output of the coal mines, and providing employment for a large number of people, had often presented itself to Mr. Whitney's mind. The success which attended the use of Cape Breton coke with the ore of Great Bell Island in the blast furnace at Ferrona and the announcement that the two political parties had come to an agreement in favour of continuing the protective duties and bounties, convinced him that the time had come for action. As in previous enterprises the subject had been studied with the aid of scientific experts, whose investigations confirmed his opinion that iron and steel could be manufactured more advantageously at Sydney than anywhere else in the world. With the data secured in these expert investigations at his command, and the confidence created by the great success he had achieved in all previous undertakings, Mr. Whitney found no difficulty in enlisting the co-operation of some of the leading capitalists of Canada and the United States in the formation of the Dominion Iron and Steel Company.

In these vast undertakings, each of them involving the expenditure of many millions of dollars, while Mr. Whitney has had the advice and financial assistance of others, in all cases his has been the brain to conceive and his the hand to execute. But for his masterful and suggestive mind, and his ability to impart to others something of his own enthusiasm and confidence, none of these great works would have been accomplished. It has not been with him merely the formation of great companies by the grouping together of existing corporations, for in almost every work to which he has turned his hand his method has been a distinctly creative one—that is, the formation, by the employment of scientific invention and discovery, of new industries, which in their development would not only bring in adequate financial returns to their promoters, but would also prove of lasting benefit to a vast number of human beings.

Much of the information about Mr. Whitney in this sketch was obtained by a Star man from the editor of one of the leading daily newspapers of Boston, who was asked to tell what he knew about the man who is taking such a foremost part in the development of the east-end of Canada. In conclusion, he said: "Mr. Whitney is intellectually and physically in the prime of life. He

is capable, as might be assumed, of great mental endurance, keeping himself in sound physical condition by frequent exercise in the saddle, and by interesting himself in other kinds of out-door enjoyment. His manners are simple and unaffected, his democratic sense of human equality making him easily approachable by all ; while his kindness of heart is even too quickly shown when an appeal is made to his generosity. A few years ago a well-known and judicially-minded Bostonian was asked to name the three greatest men in this community. After thinking a few minutes he replied : ' In religion, Phillips Brooks ; in intellectual pursuits, President Eliot of Harvard University ; in business life, Henry M. Whitney,' a classification to which most of Mr. Whitney's fellow-townsmen would readily subscribe."

The wife of one of the officials of the Dominion Coal Company in Cape Breton said to a Star man : " Mr. Whitney is a business genius, and yet he is the most unassuming man I ever met. All his employees love him. His manner is the same to an office boy as to a magnate."

There is no doubt that Mr. Whitney is a man of great personal magnetism.

Most of the Canadian directors of the Dominion Iron and Steel Company have been prominently before the people of Canada in connection with various enterprises, and their biographies having already been published in the Star, they will not require such extended notice as the president.

Taking them geographically for convenience, beginning at the west, the representatives from Toronto on the Board are : Senator Geo. A. Cox and Mr. Elias Rogers. Hon. Mr. Cox is identified with many of the most prominent business interests of Canada. He is president of the Canadian Bank of Commerce, the Canada Life Assurance Company, the Crow's Nest Pass Coal Company, the Western Fire and Marine Insurance Company, and the British American Fire and Marine Insurance Co., and is actively interested in several other important business enterprises, including the Canadian General Electric Company and the National Trust Company of Ontario, Limited, (the transfer agent for the Dominion Iron and Steel Company).

Mr. Elias Rogers is also a resident of Toronto. He is the leading coal merchant of Ontario, and a director of the Imperial Bank. From his past experience he is familiar not only with coal, but also with the iron trade of Ohio, and Pennsylvania.

In Montreal reside Sir William C. Van Horne, Mr. R. B. Angus the vice-president of the Dominion Iron and Steel Company, and Mr. James Ross. They have been so long connected with important enterprises that the mention of their names calls up not only the history of the Canadian Pacific Railway from its inception to the present time, but many of the most important Canadian industrial successes, as well as McGill University, of which both Sir William Van Horne and Mr. Angus are governors, and the three are known throughout Europe and this continent as enlightened patrons of the fine arts.

Sir William C. Van Horne, chairman of the Board of Directors of the Canadian Pacific Railway, of which he was president and general manager for many years, has a mind of extraordinary versatility, combined with great powers of concentration. No matter what a man's trade or profession may be, Sir William can talk to him understandingly about it, and business men are often astonished at his quick insight into technical matters to which they have themselves devoted years of study. He has a reputation as a mind reader among those who know him well, and some remarkable stories are told about his achievements in this direction, but this is due not to any occult influence, but to his quick reasoning powers and his faculty of reading faces and understanding the characters of those with whom he converses, either during business negotiations or in social intercourse. If he were not celebrated as a railway man, he might have a reputation as an artist, for he not only knows a good picture when he sees it, but can paint pictures himself that would do credit to artists of standing who have devoted their lives to artistic work.

He started life as an office boy in an American railway station, and before he came to Canada at the age of 38 he had distinguished himself as a successful railway man, having been superintendent and general manager of several important railways in the Western States.

Upon coming to Canada to take the management of the Canadian Pacific Railway he was given the task of carrying out the contract made with the Dominion Government to construct a railway across the continent in ten years. He completed the work in four years and a half, less than half the time called for in the contract. But it was as general manager and president after the completion of the main line that Sir William Van Horne's wonderful organizing ability and power to master the details of every line of business were most required. The railway ran through an almost uninhabited country and it had been predicted that the traffic would not pay for the grease on the car wheels. It was necessary to create business for the railway. This was accomplished by building and buying subsidiary railways, establishing steamship lines, bringing in settlers to the North-West farm lands, encouraging the establishment of industrial enterprises along the line and promoting the development of the mining resources of British Columbia and North-Western Ontario. Few Canadians realize how much the Canadian Pacific Railway Company under the direction of Sir William Van Horne has done to interest outside capital in the development of Canadian resources. Passengers on the Canadian Pacific Railway, whether rich or poor, always receive due attention from the railway officials, but it has been the policy of Sir William Van Horne to particularly please the capitalists of other countries, because he knew that Canada's wonderful natural resources could never be developed without capital from outside. Sir William Van Horne has spent a great deal of money and a great deal of time trying to impress the capitalists of Great

Britain, the United States and other countries with the resources of Canada. Many a wealthy man has gone across the continent in Sir William's private car, listening on the way to his eulogies of Canada. He is an enthusiastic believer in the great future of Canada; a talk with him about this country is sufficient to make even a pessimist hopeful, and there is no doubt whatever that the mining development, which has contributed so much to the prosperity of Canada during the last three years, is largely due to his efforts to interest outside capitalists in Canadian resources. The educating work done by the Canadian Pacific Railway Company has made it far easier for promoters to get capital for Canadian enterprises in both Great Britain and the United States. His new position as chairman of the Board of Directors of the Canadian Pacific Railway Company allows him more leisure than he had while president of the company, and he will take an active part in furthering the interests of the Dominion Iron and Steel Company.

Mr. R. B. Angus is a Scotchman by birth, but came to Canada in 1857, at the age of 27, to take a position on the staff of the Bank of Montreal, in whose service he remained for twenty-two years, becoming general manager in 1869, and holding that position until 1879, when he retired in order to take the general managership of the St. Paul, Minneapolis and Manitoba Railway. In 1880 he joined the Canadian Pacific Railway syndicate, which included Mr. George Stephen [now Lord Mount Stephen] and Mr. Donald Smith [now Lord Strathcona] and others, and he has ever since been closely identified with the great railway. He is now a director of the Bank of Montreal, of which he was formerly general manager, and is interested in a number of other successful business enterprises.

Mr. James Ross is also a Scotchman by birth, and was educated as a civil engineer, but emigrated to the United States in 1870, at the age of 22 years, and remained there for some years, acting at first as resident engineer and then as chief engineer on several railways. In 1878 he came to Canada, and built the Credit Valley Railway, of which he afterwards became general manager. He was consulting engineer of the Ontario and Quebec Railway, which later on became a part of the Canadian Pacific Railway system, and he had the contract for the construction of some of the most difficult sections of the Canadian Pacific Railway, including the Rocky Mountain section. He has since built several other Canadian railways. In recent years he has been closely identified with a number of electric railway enterprises, having taken a leading part in re-organizing the Montreal, Toronto, Winnipeg and St. John street railways and substituting electricity for horses. In 1896 he and Mr. Mackenzie acquired the street railway systems of the city of Birmingham, Eng., and introduced the electric system there, and he was one of the syndicate of Canadian capitalists who built electric tramways in Jamaica. He is vice-president of the

Montreal and Toronto Street Railway Companies, president of the Winnipeg and St. John Street Railway Companies, and president of the Dominion Bridge Company, while he is actively interested in a number of other important enterprises.

Mr. Robert McKay, another Montreal director, is well known as having succeeded his uncles in their long established and most successful importing business, which he still carries on. He is chairman of the Board of Harbour Commissioners of Montreal, president of the Bell Telephone Company of Canada, and a director of the Merchants Bank of Canada; and, like his Canadian colleagues on the board of this company, his name is familiar to all the readers of the Star.

Mr. John S. McLennan is a native of Montreal, a son of Mr. Hugh McLennan, well known in Canada as a man of very high character, a prosperous merchant, and the trusted director in many financial and business institutions, and a brother of Mr. William McLennan, the well-known Canadian author, whose novels, short stories and poems, published first in Harper's Magazine and afterwards in book form, have been highly praised by critics in both England and the United States. Mr. John S. McLennan is a graduate of McGill University and also of Cambridge, Eng. He has been identified with the mining interests of Cape Breton for about fifteen years. Previous to the year 1893 he was the resident manager of the International Coal Company, displaying signal ability in this position. On the absorption of this mine into the organization of the Dominion Coal Company, he became treasurer of the larger organization, and still retains his position. No small share of the success of the coal company is due to him, the details of the business in recent years having fallen under his immediate supervision.

Halifax, the capital of Nova Scotia, has naturally taken a keen interest in the development of this company, and has been closely identified with its inception. Four of the directors are residents of Halifax.

The Hon. David McKeen, who has lately become a resident of Halifax, commenced his career in Cape Breton before the days of the Reciprocity Treaty. Employed at first by the Caledonia Coal Company, until he ultimately became its principal owner, he saw all phases of its development, during the time of the Reciprocity Treaty, through the dark days of the Nova Scotian collieries, and gradually increasing prosperity with the development of the inter-provincial trade in coal which began in 1878. The prosperity of the Caledonia mine during the years immediately preceding its absorption in the Dominion Coal Co. in 1893, was in a large measure due to him, and as resident manager for the new company, he had charge of its interests in Cape Breton during the trying period of construction. From this position he retired with ample means, remaining on the board of the Dominion Coal Company, as well as becoming a director of the Dominion Iron and Steel Company. He is also president of the Halifax

Electric Tramway Company, and a director of the Merchants Bank of Halifax.

Another director of the same bank, who is a member of the board of the Dominion Iron and Steel Company, is Mr. Michael Dwyer. He is a native of Newfoundland, but for many years has been a successful and prominent merchant in Halifax.

Mr. W. B. Ross, Q.C., secretary of the company, is a leading member of the Bar of Nova Scotia. He is also a director of the Dominion Coal Company.

Mr. B. F. Pearson has done much to make the name of "promoters" respected in Nova Scotia. It was he who first interested Mr. Whitney in the Cape Breton coal mines and brought about the organization of the Dominion Coal Company. He also organized the Halifax Electric Tramway Company and has been closely identified with the formation of the West India Tramway Co., and large enterprises in process of formation in Havana and Brazil.

The directors who reside in the United States are Mr. H. F. Dimock and Mr. Almeric Paget, of New York. Mr. H. F. Dimock is a brother-in-law of Mr. Whitney, and has been closely associated with him in most of the important enterprises in which he has been engaged. He is the manager of the Metropolitan Steamship Co., and a director of the Dominion Coal Co., and occupies in the business and social world of New York a most enviable position. He, too, like Mr. Angus, is identified with educational institutions, and is a governor of Yale University.

Mr. Almeric H. Paget is a young Englishman, the son of Major-General Paget. After a successful business career in Minnesota, he became a resident of New York. He is a son-in-law of Mr. William C. Whitney, and by marriage a nephew of Colonel O. H. Payne, of the Standard Oil Company. He is president of the Chihuahua and Pacific Railway Company and takes an active part in the management of other corporations.

Mr. Julian Kennedy, the consulting engineer, is a man of about 45 years, and a graduate of the Yale Scientific School. His name still remains prominent in athletic circles, on account of his extraordinary success as an oarsman during his college career. But few amateurs have ever won so large a proportion of the races in which they started as he, and the vigour and determination to which these successes were due have helped him in the twenty odd years of active life since that time. There is scarcely in the United States an iron or steel works of the first importance, which, in one form or another, does not bear the marks, in some department, of his ability. Many of his inventions made some years ago still remain in the most important steel works of the United States, in spite of the extraordinary transformation of the appliances used in this great industry. Mr. Kennedy has been called on in consultation in the United States, England, Russia and China.

Mr. R. G. Wells, Mr. Kennedy's representative in Cape

Breton, is a young man who has just returned from Russia, where he had charge of the construction of large iron works. Previous to this time he was associated with Mr. Kennedy, and has been in the employment of the Illinois Steel Company.

The contractors for the greater part of this work are the Riter-Conley Manufacturing Company of Pittsburg. They have been pioneers of American industry. Much of the work manufactured in their shop at Pittsburg has been taken to Britain, Holland and other European countries, and to some of the Australian colonies.

Mr. Riter brings to this firm a very long experience as a successful contractor; a reputation of great energy, judgment and resource.

Associated with him he has a large number of able and trained assistants, prominent among whom is Mr. W. A. Coffin, the vice-president of the Riter-Conley Company, who will give close personal attention to the erection of the plant at Sydney.

The capital stock of the company is \$15,000,000 and \$6,000,000 of five per cent bonds will be issued. The capital is much more than sufficient to cover the cost of the works now being constructed extensive as they are, but it is believed that the situation of Sydney is so favourable for reaching the markets of the world that it will be necessary to increase the number of furnaces very soon after those now in course of construction are completed, and it is possible that the building of ships may be undertaken by the company.

It is said to be the first time in industrial enterprises of this kind when a large steel plant has been built concurrently with so large a blast furnace plant. Indeed it is usually the custom to build a blast furnace plant and add the steel plant later on. The advantages of the combination are always recognized, but it has been difficult or impossible to secure the necessary capital for doing the whole at once. That the large capital required for this Canadian enterprise has been obtained so quietly, apparently so easily, is abundant evidence of the faith in its financial success by the men who are prominent in it as directors and stockholders.

The capacity of the blast furnaces aggregate from 1000 to 1400 tons a day, or 400,000 tons to 500,000 tons per year. The fixed charges being interest on \$6,000,000 of bonds at 5 per cent amount to \$300,000 per year or about 75c per ton of pig iron output. This is believed to be the smallest fixed charge of any large plant in the United States or probably elsewhere.

How Iron and Steel are Made.

From the Montreal Daily Star, October 21, 1899.

VI.

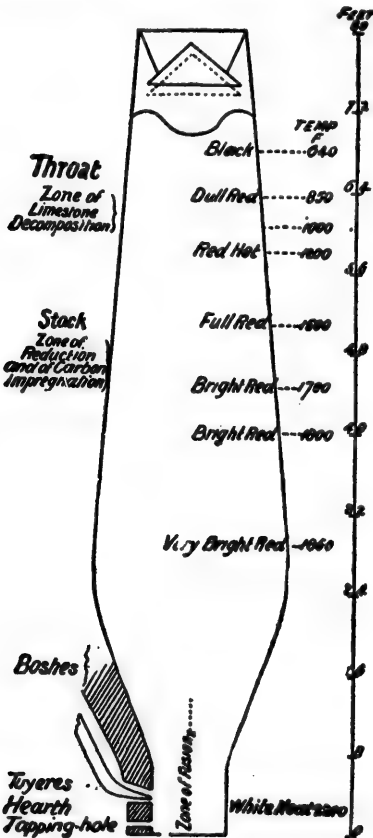


THE common conception of iron among those unacquainted with chemistry is that it is a black substance, easily fusible and readily moulded while liquid into any shape desired. In fact, pure iron is white and very difficult to fuse. What we commonly call iron—the iron which is used as a raw material in so many lines of industry, is a mixture of pure iron with other substances. If iron were easily obtainable in a pure state it would be a very simple matter to mix with it the substances required to fit it for use in the mechanic arts, but pure iron is very rare. In nature it is almost invariably found combined with oxygen and various impurities in such a way that it is even more unfit for industrial purposes than it would be in a pure state. The mineral compounds of iron are called iron ores, and the whole purpose of the complicated processes of the iron and steel works is to take away from the iron the impurities of the ore and add to it the substances which adapt it for the various industrial uses. According to a high American authority on iron-making, “iron ores are considered rich when they contain above 50 per cent. of iron: average when they contain between 50 and 35 per cent.; poor when between 35 and 25 per cent., and useless when below 25 per cent. The iron ore of Great Bell Island, which will be used by the Dominion Iron and Steel Company, contains from 54 to 59 per cent. of metallic iron, the average being fully 55 per cent. The iron ores of the great Cleveland iron district of England do not contain over 42 per cent. of iron, and the Alabama ores are said to average about 40 per cent, or a little over. The common impurities of iron ore are alumina, magnesia, lime, phosphorus, silica and sulphur. A certain percentage of some of these foreign substances may be of advantage in making iron and steel, promoting fusibility, or serving some other purpose in the process. Sometimes a substance, which is advantageous at one stage of the process must be eliminated at a later stage. It has been found that most of the common impurities of iron ore combine very readily with lime when melted and form what is called a slag, which is lighter than iron, floats on top and can be easily tapped off. The lime thus used is called a flux. The laboratory in which takes place the first process of extracting

the impurities of the iron ore and adding carbon is called a blast furnace, because the ore and other materials placed in it are fused by blasts of hot air that are blown into it. It is a high structure, the inner walls of which are built of fire bricks, the outer walls being of ordinary brick or stone work bound with iron. The raw materials which are called the "stock," are iron ore, coke and limestone. They are fed into the furnace at the

top, the quantity of each required to make a ton of pig-iron depending upon the character of the ore and fuel. Experience at Ferrona has shown that it takes 1.8 tons of Great Bell Island iron ore, 1.25 tons of Cape Breton coke and .75 of a ton of Cape Breton limestone, to make one ton of pig-iron.

A very good description of a blast furnace has been given by an American writer, Mr. R. R. Bowker, who says: "The internal shape of the blast furnace follows the general type of two truncated cones, united at the widest parts, the maximum diameter being about one-third the way up. The angle of juncture is rounded off so that the whole is in form not unlike an inverted soda water bottle with most of the neck and conical bottom cut off. The topmost section is known as the throat — very properly, for it swallows the charge. That portion extending downward from the throat to the largest diameter is called the stack. The lower portion, of narrowing diameter, is known as the boshes. The lowest section, cylindrical in shape, is the



BLAST FURNACE.

hearth or crucible. In the brick walls of this portion are built hollow cones of metal, from two to ten in number, called tuyeres, which receive the nozzles of the air-pipes. In that part of the hearth below the tuyeres the molten metal accumulates with its accompanying floating mass of slag or cinder, before it is tapped off. Around it is a strong cast or wrought iron crucible jacket, kept cool by a water spray. Towards the front is the dam-plate, at the bottom of which a channel known as the tapping hole taps the metal from the crucible. Over a notch in

the upper surface of the crucible jacket flows the discharge of slag. Flues and openings in the body of the masonry are provided for the free escape of gases and steam. The charging platform, on the top of the furnace, is supported on hollow cast-iron columns, which also serve to carry the combustible gases. These, which would otherwise escape, can be made economically valuable as fuel for heating the blast of the blowing machines and for the calcination of the materials of the charge, when this operation is effected outside of the blast furnace. There are several devices for preventing the waste of gases at the throat, and diverting them into the conducting pipes, the best being known as the cup and cone, or hopper and bell, the cone or bell being raised or lowered at will. While the above description follows the general type, the dimensions and constructions of blast furnaces vary greatly, ranging from 50 to 90 feet in height, from 6 to 25 feet in maximum diameter, and from 500 to 40,000 cubic feet in capacity. These differences are determined by the quality of the ore most available for use in the district. The blast furnace swallows and digests iron ore in a manner closely parallel to the work done by the human organs. The food is prepared before it passes down the throat; it is fully digested by the process of intense heat, waste matter is separated, and functions of excretion go on in a similar fashion; and the great fire-tower breathes through the tuyeres analagous to the human lungs using the oxygen and expelling carbonic acid gas."

Mr. Harry Huse Campbell in his interesting work on "The Manufacture and Properties of Structural Steel" has also given a description of the process which goes on in a blast-furnace. He says: "The blast-furnace is kept full of stock, and the combustion of the coke is constantly maintained by the introduction of hot blasts through the tuyeres at the hearth. Immediately in front of these tuyeres the temperature is very high, but the constant tapping of the liquid products and the constant supply of fresh stock from above prevents this high temperature from spreading upwards, as it would do if nothing were withdrawn from the bottom of the column. The region which is at a sufficiently high temperature to liquify the stock is known as the 'zone of fusion.' It reaches several feet above the tuyeres, the exact extent varying with several conditions of furnace practice. When the oxygen of the blast comes in contact with the coke it forms either carbonic acid or carbonic oxide, but if carbonic acid does form it is instantly reduced to carbonic oxide by the next atom of carbon, so that when the gases leave the zone of fusion and travel upward through the stock to the top of the furnace they may be regarded as a mixture of carbonic oxide and the nitrogen of the blast. The carbonic oxide absorbs the oxygen from the ore, forming carbonic acid, and leaves the iron in the finely divided metallic state known as spongy iron. On reaching the lower and hotter parts of the furnace near the zone of fusion, the spongy iron absorbs carbon from the coke, and is

thus converted into 'pig-iron,' which may be regarded as carbide of iron, the percentage of carbon usually running from three to four per cent. The iron also absorbs some silicon, phosphorus and sulphur from the earthy ingredients of the charge. These probably exist in the pig-iron as silicide, phosphide and sulphide of iron. In addition to the coke which is charged with the ore, a certain proportion of limestone is added. The carbonic acid of this stone is expelled in the upper part of the furnace, and caustic lime remains. In rare cases the stone has been subjected to a preliminary calcining, but the economy of this practice is not yet demonstrated. The amount of limestone is regulated so that it will satisfy the silica contained in the ore and in the ash of the coke, and give a slag which is sufficiently acid to be liquid and run freely from the furnace, and which is also sufficiently basic to absorb the sulphur from the coke and ore. At the top of the furnace there is an enormous volume of escaping gas derived from the passage of the blast through the column of burning coke and ore. This is composed of nitrogen, together with some carbonic acid and a larger proportion of carbonic oxide, the percentage of the latter being sufficient to make the mixture available as fuel. Part of this gas is burned under boilers to furnish steam for the blowing engines, while the remainder is used for the reheating of the blast. Formerly the air was heated by forcing it through iron pipes which were surrounded by burning gases, but of late years it is the almost universal practice to have a set of brick stoves, filled with long, narrow passages. By passing burning gas through a stove for an hour or more, the bricks are heated to a high temperature, whereupon the air is blown through in an opposite direction and is heated to nearly the same point. The stoves are used alternately, so that by means of suitable valves, the action is practically continuous. In well-equipped furnaces the temperature of the blast is maintained between 1,000 degrees F. and 1,200 degrees F., these figures being exceeded under favourable conditions."

It should be explained that when the chemical process in the blast furnace is completed the slag which floats on top is first tapped off and then the melted metal is tapped either into ladles or into moulds in sand. According to the old fashioned method which is still generally in vogue long troughs are made in the sand and from each of these troughs extend branches. The main troughs are called sows, while the branches are called pigs. The hot metal, flowing out of the furnace, runs along the main trough until it reaches the first branch which it fills, and then goes on to the next, and so on until pigs and sows are filled with metal which cools in the sand. The iron thus produced is called cast iron or pig iron. Some of the sand always sticks to the metal. Formerly the pigs had to be broken off by hand from the sow, but this is now done by machinery. However, this old-fashioned method while still generally used in England and largely in the United States is rapidly being superseded in the

United States by a system known as the Uehling metal conveying and casting arrangement. By this method, as described by Mr. H. M. Howe, the cast iron is tapped from the blast furnace directly into a large ladle, which is carried by rail to a central casting machine, placed so as to be used for all the furnaces of the establishment. The casting arrangement consists essentially of a "Jacob's ladder," or common bucket elevator, of which the buckets and their supporting belt are replaced by a series of horizontal trough-shaped, open, cast-iron moulds, their ends supported and carried by the two parallel endless chains which form the skeleton of the elevator. This, in rising very gradually carries these moulds successively under and past the lip of the ladle which contains the molten cast iron from the blast furnace. The ladle tips progressively, and fills the passing moulds one after another. They pass on slowly up the elevator, so slowly that by the time any one of them has reached the top of the elevator the pig which it contains has solidified. When the mould passes the sheave at the top, the pig is dumped out upon another conveyor, which is horizontal and partly submerged in water. Here the pig cools off more quickly and is carried forward by this conveyor, and by it in turn dumped into a railroad car. On its return passage the elevator which carries the moulds is sprayed with water, and, if desired, with limewash. So, too, on its upward travel, while carrying the hot pigs, it may be sprayed to hasten their cooling. This method has the advantage over that of casting the pigs attached to a sow and then breaking them up, that it saves a large expenditure of power, and the advocates of it argue that as the iron is to be used in small pieces it should be cast in small pieces. We understand that the Sydney works of the Dominion Iron and Steel Company will be equipped with both a sand house and the more modern apparatus for tapping the metal into ladles, so that either method can be used as desired.

Pig or cast iron is easily melted and as it can be readily cast in moulds it is very useful for foundry purposes, but being hard, rigid and brittle, it must go through other processes to make it malleable, and upon reaching the latter condition it is called wrought iron.

The most important difference between pig or cast iron and wrought iron is in the quantity of carbon they contain, the percentage of carbon in pig-iron running from 2.1-2 to 4 per cent., while wrought iron generally contains less than 20-100 of 1 per cent.; and steel usually from 10-100 of 1 per cent. to 2.1-2 per cent. In ordering wrought iron and steel from the manufacturer it is customary to specify about what percentage of carbon is desired, 1-100 of 1 per cent. being accepted as the unit and called one carbon. Steel with a very small percentage of carbon is soft, while steel with a large percentage of carbon is hard. Before the discovery of the Bessemer and open-hearth methods

of steel-making the dividing line between wrought iron and steel was very sharply drawn according to the quantity of carbon they contained. If iron would harden in water it was called steel. But some varieties of steel made by the new processes are so soft as to closely resemble wrought iron and the distinction between them and wrought iron is more a matter of molecular structure due to the different processes of manufacture than of difference in the quantity of carbon they contain.

Pig-iron is converted into wrought iron by a series of processes, the first of which is called puddling, an operation which is conducted in a reverberatory furnace with a fettling of iron ore. The pig-iron is melted and the fettling is stirred into it. The silicon, manganese, sulphur and phosphorus in the pig-iron unite with the oxygen and iron oxide of the iron ore to form a slag, while the carbon escapes in the form of carbonic acid and carbonic oxide. But the particles of iron separated from the impurities are not easily fusible and the heat of the reverberatory furnace, although great enough to melt the pig-iron and iron ore, not being sufficient to keep the mass liquid, it soon becomes pasty in which state it is worked into balls. The puddled ball as it comes from the furnace is a mass of globules of nearly pure iron separated from each other by particles of slag. It is squeezed, hammered and rolled until it becomes wrought iron. The squeezing process removes a great part of the slag and more is expelled in the processes of hammering and rolling, but even the finished bar of iron is permeated by minute particles of cinder.

Mr. R. R. Bowker gives a very clear description of the difference between a bar of wrought iron and steel which reads as follows: "The wrought iron bar resembles a bunch of iron fibres or sinews with minute particles of slag interspersed here and there. Such iron varies in resistance according to whether the power is applied with or against the fibre. Steel is the result of a fusing process. It may be crucible, Bessemer or open-hearth steel, but in all cases it has been cast from a thoroughly melted and fluid state into an ingot mould, where it solidifies and is ready for subsequent treatment, such as hammering or rolling. The slag being lighter than the steel, it rises on top of the melted bath and does not mingle with the metal, which remains clear and unobstructed, and after being cast in the mould cools into a crystalline homogeneous mass in which no amount of rolling can develop a fibre. Thus steel possesses a structure more regular and compact than wrought iron. Its resistance to strains and stresses is more equal in all directions, and its adaptability to structural use is vastly increased."

During recent years steel has been gradually superseding wrought iron for a great variety of purposes.

Now as to the three methods of making steel. Crucible steel is commonly made by placing small pieces of wrought iron together with some black oxide of manganese in melting pots

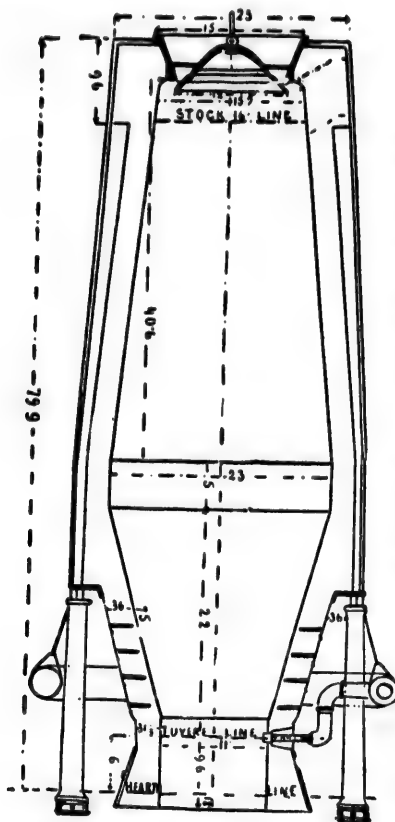
called crucibles made of materials containing a good deal of carbon, charcoal being placed in the pot if the quantity of carbon in the material of the crucible is not sufficient. The crucibles are heated in furnaces and are removed with tongs when the metal is melted, and the iron poured into moulds. Sometimes the wrought iron is subjected to a process of cementation by heating it in fine charcoal before using it in the crucible. The process of making crucible steel is an expensive one and it is only used for making steel for razors and other purposes for which a very high quality of steel is required.

But there are two modern methods of making steel by which it can be produced cheaply. One is called the Bessemer process after the name of the inventor and the other is known as the open-hearth system. The Bessemer process consists in blowing air into liquid pig-iron for the purpose of burning out the impurities in such a manner that the product is entirely fluid. The operation is performed in a converter and the air is blown upward through the metal. By the open-hearth process pig-iron, or a mixture of pig-iron with scrap iron and scrap steel, is exposed to the direct action of the flame in a regenerative gas furnace, the operation being so conducted that the final product is entirely fluid.

In both the Bessemer and open-hearth systems the extent to which the two great enemies of steel, phosphorus and sulphur, are eliminated depends upon the character of the lining of the converter or of the furnace. The lining may be acid or basic. An acid lining contains a considerable quantity of silicic acid or silica, the substance chiefly used being fire-clay. A basic lining consists of the alkaline oxides of earthy metals or bases, the substances generally used being dolomite, lime and magnesite. When an acid lining is used comparatively little of the sulphur and phosphorus can be eliminated, and consequently in the acid processes only iron which is nearly free from these injurious alloys can be used. In the basic Bessemer process the sulphur and phosphorus are to a great extent eliminated, but the quality of the product is uncertain. In the basic open-hearth process all or almost all the sulphur and phosphorus are eliminated and the character of the product can be calculated upon with certainty.

Thus the basic open-hearth process of steel-making possesses great advantages over the Bessemer. Even with pig-iron made from inferior ore the steel made in the open-hearth furnace is superior to that produced in the Bessemer converter, which can only use pig-iron made with high-grade ores almost free from phosphorus. The open-hearth process is especially advantageous in making high-carbon steel. By the Bessemer process nearly all the carbon is blown out, producing a soft metal, and in order to secure high-carbon steel more carbon must be mixed in. It is difficult to do this in such a way as to secure homogeneity. But in the open-hearth furnace, according to Mr. H. H. Camp-

bell, "it is possible to make regularly a steel of any carbon desired from .05 to 1.50 per cent., with phosphorus below .04 per cent., with manganese below .50 per cent., and sulphur below .04 per cent." The open-hearth process is more prolonged than the Bessemer; it can be interrupted at the proper stage to secure the amount of carbon desired and no mixing of the carbon is required.



TYPE OF BLAST FURNACE TO
BE USED AT SYDNEY.

Phosphorus causes brittleness in steel when cold; while sulphur causes brittleness when red hot and makes it unweldable, so it is extremely important that both these substances should be got rid of.

The Bessemer converter presents a brilliant sight to the spectator as the flames belch forth from its mouth. There is nothing brilliant about the open-hearth furnace. It does its work quietly, but the product is better.

Open-hearth steel is preferred to Bessemer steel for all structural purposes, for ship-building and armour-plates. For rails the Bessemer steel is used almost entirely in the United States, but in Europe open-hearth steel is rapidly superseding Bessemer steel even for rails. The reason why Bessemer steel rails are more generally used is because they are cheaper, not because they are better than open-hearth steel rails.

In the Northern States the process generally adopted is the acid Bessemer, but the open-hearth method is gaining

ground. In the South the open-hearth method is used almost exclusively. The following table, giving the quantity of steel produced in the United States by the different methods in 1894 and 1898, will show how rapidly the production of open-hearth steel is increasing, as compared with other steels:

PRODUCTION OF STEEL IN THE UNITED STATES.

Kinds.	1894. Tons.	1898. Tons.
Bessemer	3,571,313	6,609,017
Open-Hearth.	784,936	2,230,292
Crucible.	51,702	89,747
Miscellaneous	4,031	3,801

The readers of the Star will now be able to understand a description of the works that are being constructed in Sydney, C.B., for the Dominion Iron and Steel Company. There are to be four blast furnaces, each having an average capacity of 250 tons of pig-iron per day under ordinary conditions, but as stated in a previous article, it is expected in view of the experience at Ferrona, that Great Bell Island ore and Cape Breton coke will work so well together in the furnace that the average output will be larger. The blast furnaces will be of the same general type as those used in the Edgar Thompson Steel Works at Pittsburg, Pa. The height will be eighty-five feet and the diameter nineteen feet. In the steel mill the basic open-hearth system will be exclusively used, but the exact type of furnace has not been definitely decided upon. Hundreds of men are now working at the foundations of the works, but it will be some time before the steel mill is so far completed as to be ready for the furnaces, so that there will be time for consideration, and the best type of furnace with the most modern improvements that have been tested by experience can be chosen. There will be from ten to twelve open-hearth furnaces in the steel mill. The material used in making steel will be practically all pig-iron or hot metal from the blast furnaces of the company, but a small percentage of scrap iron and steel will be used. Generally the metal will be taken to the steel mill in a liquid state, as it comes hot from the furnaces, but the moulded pig-iron can be used when desired either with or without the hot liquid.

The blast furnaces will cost about \$2,500,000, the steel mill about \$1,500,000; the coke ovens previously described about \$1,250,000, and wharves, discharging plant, foundations, freight, duties and incidentals fully a million more.

Cost of Making Pig Iron at Sydney.

From the Montreal Daily Star, October 28, 1899.

VII.

NOT only to the capitalists directly interested in the Dominion Iron and Steel Company, but to the whole Canadian people, the commercial success of the company is a matter of great importance. If Canada is to become a great nation the resources of the Maritime Provinces must be developed. So long as our Atlantic seaboard, the portion of the country nearest to the great nations of Europe, remains sparsely settled while there are populous centres of industry all along the Atlantic coast of the United States, Canada will suffer by comparison with its neighbour in the eyes of all Europe. The building up of a big manufacturing city at the front door of Canada will give our Dominion, new importance in the eyes of the world. There are very few countries that export iron and steel, and if Canada can take rank among the iron exporting nations it will add greatly to Canadian prestige.

If the capitalists who are investing so much money in establishing a great iron industry in Cape Breton make very large profits it will be known in England and the United States and will create a feeling of confidence in Canadian investments which will make it easier to obtain capital to develop the great natural resources of every part of Canada. The fact that British capitalists lost so much money in the Grand Trunk Railway and some other Canadian investments years ago greatly retarded the development of this country by causing an immense amount of capital, which would otherwise have been invested in the Dominion, to go to the United States, the Argentine Republic and other countries. All investments in the United States were not successful, British capital was lost there just as it was lost in the Grand Trunk Railway, but there were some cases of extraordinary profits that offset the losses and when a stockholder in some unsuccessful American concern began to talk of his losses there was always a stockholder in some successful concern to tell of the great profits he had made. Canada until recently could show no extraordinary commercial successes to offset a few great failures,

The country was prosperous, the people in general were probably in more comfortable circumstances than those of any other nation, but we had no striking examples of great fortunes being made in Canadian investments to cause people of other countries to talk about the Dominion as a land in which it would pay to invest money. The recent improvement in the financial condition of the Grand Trunk Railway, the great success of the Canadian Pacific Railway and the rich returns from some of the mining ventures in the Canadian West have given the investors of the world more confidence in Canada than they ever had before, and if the Dominion Iron and Steel Company should prove to be an extraordinary commercial success it will have a very great influence in attracting capital not only to the Maritime Provinces, but to all sections of Canada. The readers of the Star will therefore be interested in knowing how much it will cost to make iron in Cape Breton, at what price it can be sold and where it will find a market.

The Dominion Iron and Steel Company, in making estimates as to the cost of manufacturing iron and steel at Sydney have the advantage of knowing what has been accomplished by the Nova Scotia Steel Company in making pig-iron at Ferrona with the iron ore of Great Bell Island and coke from Cape Breton coal, and in making steel at Trenton near New Glasgow from Ferrona pig-iron. The chief differences are that the iron ore, coal and limestone are much closer together at Sydney than at Ferrona and that the Dominion Iron and Steel Company will manufacture iron and steel on a much larger scale than they have ever been made at Ferrona and Trenton.

The Nova Scotia Steel Company have estimated that the cost of making pig-iron in the neighbourhood of Sydney Harbour would be less than \$5.50 per ton including fixed charges so long as the iron ore of Great Bell Island can be mined open cut, and when underground mining has to be resorted to that the cost of a ton of pig-iron will not exceed \$5.83 including fixed charges. Careful estimates made by experts for the Dominion Iron and Steel Company correspond with this estimate very closely, so it may be assumed that the cost of making pig-iron at Sydney with the ore of Great Bell Island will never exceed six dollars per ton under normal conditions. During a period of great prosperity when high prices prevail for everything and wages rise the cost of making iron and steel will no doubt be somewhat greater than at ordinary times, but owing to the fact that the Dominion Iron and Steel Company have iron mines of their own and have a permanent arrangement with the Dominion Coal Company for a supply of cheap coal, the cost of production is not likely to vary as much in good and bad times as at iron works which are obliged to buy their raw materials in a fluctuating market.

It may be noted that in the estimate of the Dominion Iron and Steel Company the price of iron ore is fixed at what the ore

of Great Bell Island will cost when underground mining has to be resorted to. It should also be stated that in estimating the cost of coke, the value of the by-products is deducted as the volatile constituents of the coal, which are usually lost in making coke, will be saved by the Otto-Hoffman by-product coke ovens as explained in a previous article. The estimate of the Nova Scotia Steel Company does not allow anything for the value of by-products. It will be easily understood that the Dominion Coal Company can afford to supply the Dominion Iron and Steel Company with coal at a much lower price than it could be profitably sold in small quantities to the general public at a distance from the mines. The constant demand for coal for use in the iron works will enable the company to operate its mines at their full capacity all the year around instead of closing them partially during the period when the St. Lawrence cannot be navigated. It is a well known law of production that the larger the output in any industrial enterprise the cheaper the product can be turned out. The blast furnaces of the Dominion Iron and Steel Company will require about a million tons of coal annually for coke, and the coal company can turn out this extra quantity at a lower cost per ton than it can mine the present output. There will be no transportation charges and no middlemen's profits. In mining bituminous coal and handling it afterwards a great deal of it is broken into such small fragments that it is not saleable for ordinary purposes. This fine coal, much of which is simply coal dust, is called slack and it used to be a waste product of the mines, but it makes excellent coke. The coal company will not have sufficient slack to fully supply the iron company and a considerable quantity of larger coal must be used, but the fact that a portion of the coal used will be slack helps to fix the price.

Following is the estimate of the Dominion Iron and Steel Company in detail :

1.8 tons of ore.....	\$1 80
1.25 tons of coke.....	1.80
.75 ton of limestone.....	.40
Labour, repairs and incidentals.....	1.50
	\$5.50

This estimate is for pig-iron made exclusively from the ore of the Wabana Mine, Great Bell Island, Newfoundland. It is probable that the Dominion Iron and Steel Company will sometimes mix small quantities of more expensive ores with the Wabana ore in order to produce different varieties of pig-iron, and this may slightly increase the cost per ton. As stated in a previous article the company owns a valuable mine in Cuba, and the works are favourably located for securing iron ores of any quality desired by water from outside points.

To convert the pig-iron into steel billets will cost about five dollars per ton, so that steel billets can be produced for about \$10.50.

Let us compare these figures with prices at Pittsburg, Pa., for the last twelve years. According to the report of the American Iron and Steel Association the average annual prices of these articles at Pittsburg for a series of years beginning with 1887 was as follows :

PRICES OF IRON AND STEEL AT PITTSBURG.

Years.	Gray Forge Pig-Iron.	Bessemer Pig-Iron.	Bessemer Steel Billets at Mills.	Bessemer Steel Rails at Mills.
1887.....	\$19 02	\$21 37	\$32 55	\$37 08
1888.....	15 99	17 38	28 78	29 83
1889.....	15 37	18 00	29 45	29 25
1890.....	15 78	18 85	30 32	31 75
1891.....	14 06	15 95	25 32	29 92
1892.....	12 81	14 37	23 63	30 00
1893.....	11 77	12 87	20 44	28 12
1894.....	9 75	11 38	16 58	24 00
1895.....	10 94	12 72	18 48	24 33
1896.....	10 39	12 14	18 83	18 00
1897.....	9 03	10 13	15 08	18 73
1898.....	9 18	10 33	15 31	17 62

During the last three months according to the Iron Age the price of gray forge pig-iron at Pittsburg has ranged from \$17 to \$21.50 and the price of Bessemer pig-iron from \$20.35 to \$24. Bessemer steel billets have ranged in price from \$35 to \$40, while basic open-hearth steel billets have been sold from \$42.50 to \$45. When prices are normal basic open-hearth steel is usually worth from one dollar to two dollars more than Bessemer steel. The prices of all kinds of iron and steel have been abnormally high of late, but on the other hand they were abnormally low during the period from 1892 to 1898 inclusive.

Pig-iron is made cheaper in Alabama than anywhere else in the world. In Birmingham, the centre of the Alabama iron district, during a period of extreme depression, the price of No. 1 Foundry pig-iron has fallen as low as \$7, No. 3 Foundry pig-iron \$6 and Gray Forge pig-iron \$5.75, for a short time ; but Birmingham is 276 miles from Mobile, the nearest seaport, and that seaport is 2,199 miles farther from Liverpool than Sydney is. The following table shows the highest and lowest prices of three representative grades of pig-iron in Birmingham for each year from 1890 to 1899 inclusive :

PRICES OF PIG IRON IN BIRMINGHAM, ALA.

Years.	No. 1 Foundry.		No. 3 Foundry.		Gray Forge.	
	Highest	Lowest	Highest	Lowest	Highest	Lowest
1890.....	\$16 00	\$12 00	\$13 65	\$ 9 85	\$11 90	\$ 9 60
1891.....	12 65	12 10	10 75	10 50	10 75	9 30
1892.....	12 25	10 00	10 00	8 90	9 50	8 25
1893.....	11 30	9 25	9 35	7 50	9 15	6 90
1894.....	9 70	7 75	8 00	6 50	7 00	6 25
1895.....	10 25	7 25	9 75	6 05	9 75	5 90
1896.....	9 25	7 75	8 90	6 20	7 15	6 00
1897.....	8 00	7 00	6 75	6 00	6 50	5 75
1898.....	8 25	7 50	7 90	6 60	6 70	6 15
1899.....	18 50	8 25	16 50	7 80	16 00	7 00

Hamilton pig-iron has sold at the furnace this year as high as \$23, and in Montreal as high as \$25 per ton. Last year Hamilton pig-iron went as low as \$12 at the furnace and \$14 in Montreal. The lowest price at which Ferrona pig-iron was ever sold in Montreal was \$13.50 and the highest price \$24.50.

In Montreal the average annual prices of "Summerlee" pig-iron, a Scotch brand, somewhat similiar to Ferrona pig-iron, from 1890 to 1899, inclusive, have been as follows :

PRICES OF "SUMMERLEE" PIG IRON IN MONTREAL.

Years.	Prices.
1890.....	\$22 00
1891.....	21 50
1892.....	19 00
1893.....	18 50
1894.....	20 00
1895.....	19 25
1896.....	19 00
1897.....	17 00
1898.....	17 00
1899.....	25 00

In Glasgow, Scotland, in September, 1899, the price of No. 1 Summerlee pig-iron was 85s, equivalent to \$20.68, while the price of No. 3, the lowest grade of Summerlee pig-iron, was 78s, equivalent to \$18.98. Last year No. 1 Summerlee pig-iron in Glasgow ranged in price from 51s to 57s. In July 1896, No. 1 Summerlee pig-iron in Glasgow went as low as 49s 9d, or \$12.11, and No. 3 Summerlee as low as 47s 6d, or \$11.56. At the same time steel billets sold at £4 2s 6d, or \$20.08. Steel billets have recently been sold in Glasgow as high as £6 5s, equivalent to \$30.42. The lowest grades of Scotch pig-iron which are collected in the warrant yards and sold under the name of Scotch "Warrants" have reached the price of 75s 7d, or \$18.40 this year. In 1888 Scotch "Warrants" at one time sold as low as 37s 1d, or \$9.03. The following table gives the highest, lowest, and average prices of Scotch "Warrants" at Glasgow, from 1887 to 1898, inclusive, expressed in dollars and cents.

PRICES OF SCOTCH "WARRANTS" AT GLASGOW.

Years.	Highest	Lowest	Average
1887.....	\$11.60	\$ 9.36	\$10.28
1888.....	10.58	9.03	9.70
1889.....	15.60	9.93	11.62
1890.....	15.88	10.54	12.07
1891.....	14.36	10.25	11.48
1892.....	11.47	9.60	10.17
1893.....	12.41	9.76	10.30
1894.....	10.76	10.10	10.38
1895.....	11.95	9.98	10.80
1896.....	12.00	10.90	11.40
1897.....	11.90	10.52	11.03
1898.....	12.27	11.00	11.48

Allowing \$2.50 for the cost of freight from Sydney to British ports, the pig-iron of the Dominion Iron and Steel Com-

pany could be laid down in Great Britain for \$8 and steel billets for \$13 per ton. As no pig-iron has ever been shipped from Sydney, the exact cost of freight to Great Britain cannot be given, but it is likely to be less than \$2.50 per ton soon after the Dominion Iron and Steel Company have established a market for their products in Great Britain, and are able to guarantee large shipments regularly. The freight on a ton of pig-iron from Glasgow to Montreal has ranged from 2s 6d to 6s per ton, while the freight on pig-iron from Montreal to Liverpool ranges from 10s to 12s 6d. But the shipments of pig-iron from Montreal to Great Britain have never been large, and there is no doubt that better rates might be obtained if large shipments were regularly made. Moreover, Montreal is 2,773 miles from Liverpool, while the distance from Sydney is only 2,282 miles. The Dominion Iron and Steel Company will do business on an immense scale, and will, therefore, be able to make most favourable terms with steamship companies for the transportation of iron and steel to Great Britain and other countries of Europe, South America, Africa and Asia as well as to American and Canadian ports. The freight on Ferrona pig-iron from New Glasgow, N.S., to Montreal, by water, has ranged from \$1.50 to \$2 per ton. By rail it is \$2.93. During the season of St. Lawrence navigation the freight rate on pig-iron from Sydney to Montreal would be at least as low as from New Glasgow to Montreal, for the number of ships running on the former route is much greater.

It is evident from the above figures that the Dominion Iron and Steel Company will be able to sell iron and steel at a profit, even when prices are at the lowest ebb during periods of world-wide depression. It is certain that there will be in the future, as there have been in the past, cycles of good and bad times, and in estimating the profits of the Dominion Iron and Steel Company it would be as unfair to take the prices that prevailed in a period of world-wide depression as it would be to take those prevailing during this year of extraordinary prosperity.

The Markets for Iron and Steel.

From the Montreal Daily Star, November 3, 1899.

VIII.

HE population of the United States is only about thirteen times as great as that of Canada, but in the year 1898 for every ton of pig-iron produced in Canada 161 tons were produced in the United States. The output of the blast furnaces of the United States was 11,773,934 tons, while only 73,039 tons were produced in Canada. In addition to the pig iron made in this country, Canada consumed 40,995 tons of imported pig-iron and cast iron scrap, making a total consumption of 114,035 tons. If the same quantity of pig-iron per head of population were used in Canada as is used in the United States about 900,000 tons of pig-iron would be required. It has been said that the quantity of iron consumed in a country per head of population is a measure of its civilization. Is Canada so far behind the United States in civilization as these figures would indicate? No one who has travelled through the two countries will think so for a moment. The explanation is that pig-iron is simply a raw material for a great variety of iron and steel manufactures, and Canada imports a far greater quantity of manufactures of iron and steel in proportion to population than the United States. In the year 1898 the value of iron and steel and manufactures thereof imported into Canada was \$16,556,761. During the same year the value of iron and steel and manufactures thereof imported into the United States was only \$12,473,637. If the Americans had imported as large a quantity per capita as Canadians, the value of their importations would have been over \$215,000,000. It is evident that Canadians are not behind the age as regards the consumption of iron and steel, but we get from other countries what we ought to make at home.

In the past Canadian manufacturers using iron and steel as raw materials have been at a disadvantage because these articles have been made in Canada in such small quantities that the prices prevailing here have been much higher than in Great Britain, the United States and other great iron countries. But when the works of the Dominion Iron and Steel Company at

Sydney, C. B., are in full operation it will be possible to obtain pig-iron and steel billets as cheaply in Canada as in any other country in the world, and there ought to be an extraordinary development of all the industries using iron and steel as raw materials.

Even with our present population, if all the iron and steel articles used in Canada were made in Canada from Canadian pig-iron and Canadian steel, we would require nearly twice as much pig-iron as the four great blast furnaces of the Dominion Iron and Steel Company and all the other blast furnaces now in operation in Canada could produce. But Canada will not stand still as regards population. We have entered upon a period of great national development. Our farm lands are being rapidly settled, our mines of gold, silver, copper, lead and nickel are being developed, the cities and towns are growing rapidly in population and wealth, and the demand for iron and steel is increasing every year.

Not many years ago Canada imported nearly all its manufactures of iron and steel from Great Britain. During the last few years a great change has taken place. American iron and steel articles have almost completely displaced the British articles in the Canadian market. Another change is coming. Canadian manufactures will displace American manufactures in the Canadian market. No doubt in many cases American concerns that now have an extensive trade in Canada will start branch manufacturing establishments in this country. There is a splendid field for enterprise in supplying the people of Canada with all kinds of articles made of iron and steel. Sydney, C.B., will offer special advantages as a location for such industries, and no doubt the Dominion Iron and Steel Company will do all in their power to encourage the establishment in the vicinity of their works of manufactories using iron and steel as raw materials, but such industries will not be confined to any one town or any one province. During the season of navigation pig-iron and steel from Sydney can be laid down in Montreal very cheaply, and as the enlargement of the St. Lawrence canals is now practically completed and boats drawing 14 feet of water will be able to go from Sydney to the head of the great lakes, no doubt Cape Breton iron and steel will be able to compete successfully with the products of Pennsylvania in the markets of Ontario.

But the Dominion Iron and Steel Company will not be entirely dependent upon Canadian demands for their products. Indeed, it is probable that their whole output could be sold in Great Britain, Germany, Belgium and other markets outside of Canada. It was shown in a previous article that the supplies of iron ore in Great Britain and other countries of Europe are rapidly being exhausted, that Great Britain has long been dependent upon Spain for iron ore, and the Spanish mines are giving out. At the present time England is importing iron ore from the Gellivara district of Sweden, which is considerably north of the Arctic circle. The ore is carried by rail across

Sweden and Norway to the Norwegian harbour of Ofoten, 130 miles north of the Arctic circle, where it is shipped to the British blast furnaces.

The supplies of coke in Germany and Belgium are not sufficient for their requirements, and they are obliged to import considerable quantities of pig-iron chiefly from Great Britain.

Germany annually imports between 400,000 and 500,000 tons of pig-iron, and Belgium about 300,000 tons. In both of these countries the manufacture of steel is carried on very extensively, and the output of their blast furnaces is not large enough to meet the demands of the steel mills. It has been shown in a previous article that Cape Breton pig-iron can be laid down in Great Britain at a cost considerably below even the lowest prices of British iron, so that it should have no difficulty in competing with British pig-iron in Germany and Belgium. France last year imported over two million tons of ore for use in its blast furnaces,

While the supplies of ore in the iron-making countries of Europe are becoming exhausted, iron is being used more extensively every year for a great variety of purposes. In the *Engineering Magazine* for October, Mr. Archer Brown, of the great iron firm of Rogers, Brown & Co., New York, has an interesting article on the future of the American iron industry, in which he shows that the consumption of iron and steel in the United States doubles once in ten years. He gives figures showing that the consumption of iron and steel per capita is steadily increasing in all countries. He says: "The world's consumption of pig-iron grows in geometrical ratio. In 1740 it did not amount to one pound for each inhabitant. In 1856 it was about 17 pounds per capita; in 1890 it was 35 pounds per capita; in 1900 it will probably be 60 pounds per capita."

In 1890 the consumption per capita in the United States was 300 pounds, in Great Britain 250 pounds, in France, Germany and Belgium 175 pounds.

The opening up of Africa to civilization will greatly increase the demand for iron and steel, which will be required for railways, bridges and many other purposes.

Within the last ten years the iron and steel manufacturers of the United States have developed an important export business. In 1880 the exports of iron and steel, and manufactures thereof from the United States amounted in value to only \$15,156,703, while the imports were valued at \$80,443,362. In 1898, while the imports had decreased to \$12,473,637, the exports of iron and steel had increased to \$91,844,934, including the exports of agricultural implements which were valued at \$9,073,384. The exports of pig-iron were not large, nearly the whole quantity exported, except what came to Canada, going from the

Southern States. The pig-iron exports for the year classed by ports of shipment, were as follows ;

	Tons.	Value.
Norfolk	53,438	\$534,397
New Orleans	51,703	674,516
Pensacola	23,313	226,540
Brunswick	19,032	190,310
New York	18,620	369,651
Baltimore	14,164	368,380
Mobile	13,295	126,690
All other ports	69,121	778,526
Total	262,686	\$3,269,010

A larger quantity of pig-iron might have been exported, but the output was not much more than sufficient to supply the manufacturers of the United States.

The American iron and steel exports consist chiefly of articles made of iron and steel, including steel rails, steel sheets and plates, structural iron and steel, wire, nails and spikes, tacks, car wheels, cutlery, firearms, locks, hinges and other hardware, saws, tools, electrical machinery, metal working machinery, pumps and pumping machinery, sewing machines, shoemaking machinery, fire engines, locomotive engines, stationary engines, parts of engines and boilers, pipes and fittings, safes, scales and balances, stoves, ranges, agricultural machinery, bicycles, etc., etc.

Sydney would be an admirable location for the manufacture of most of these articles, both for export and for the home market, which as already shown is now supplied almost entirely by the manufacturers of the United States. With cheap iron and steel, cheap fuel, at tidewater with a magnificent harbour nearer to the markets of Europe, Asia, Africa and South America than any port of the United States manufacturers locating there should be able to compete with those of the United States in exporting all kinds of articles made of iron and steel. Already the Montreal Rolling Mills Company are considering a proposal to establish a branch at Sydney and will probably do so if satisfactory arrangements can be made with the town of Sydney as regards site and taxation.

The following table shows the distances from Sydney, C.B., Pittsburg, Pa., and Birmingham, Alabama, to various markets :

—DISTANCES FROM—			
Sydney.	Pittsburg.	Birmingham.	To
2,282	3,514	4,782	Liverpool
2,564	3,762	5,030	Antwerp
6,467	7,224	7,585	Cape Town
3,567	4,100	4,409	Pernambuco
5,110	5,643	5,952	Buenos Ayres
8,331	8,864	9,173	Valparaiso
12,961	13,494	13,803	San Francisco
13,071	13,604	13,913	Honolulu
12,350	13,107	13,468	Melbourne
600	675	1,275	Boston
719	710	1,270	Montreal

It should be noted that the distances from Pittsburg and Birmingham are partly by railway while from Sydney they are by deep water all the way. It is unnecessary to say that deep water transportation is much cheaper than railway transportation.

This table of distances is based upon figures furnished by Capt. W. H. Smith, R.N.R., chairman of the Board of Examiners of Masters and Mates, Marine Department, Halifax, by the United States Commissioner of Navigation and the United States Bureau of Statistics at Washington, the railway distances from Pittsburg to Philadelphia and from Birmingham, Ala., to Mobile being added to the ocean distances. The distance from Sydney to Montreal is taken from the table of distances in a report issued by the Harbour Commissioners of Montreal and is measured from Low Point Lighthouse, at the mouth of Sydney Harbour. The distance from the pier of the Dominion Iron and Steel Company would be seven or eight miles greater. The distances from Pittsburg and Birmingham to Montreal and Boston are all rail.

One of the possibilities of the near future is the revival of shipbuilding in the Maritime Provinces, which in the days of wooden ships built more vessels in proportion to population than any other country. Ship plates can probably be made more cheaply in Sydney than anywhere else in the world and the Dominion Iron and Steel Company contemplate their manufacture on an extensive scale, either for home consumption or for export.

The Right Man for Manager.

From the Montreal Daily Star, November 22, 1899.

IX.

ALL Canadians who have been watching the development at Sydney, Cape Breton, of the Dominion Iron and Steel Company's enterprise, which promises to make Canada one of the leading iron and steel exporting countries of the world, will be interested in knowing something about Mr. Arthur J. Moxham, who was appointed manager of the company at the meeting of the Board of Directors in Montreal yesterday.

Having learned from Mr. Henry M. Whitney that he hoped to secure Mr. Moxham as manager, the Star has instituted special enquiries among iron and steel men in the United States to ascertain his fitness for this responsible position. Mr. Charles Kirchoff, editor of the Iron Age, than whom there is no better authority in the United States, being asked by a Star man what he thought of the appointment, said: "If it is true that the Dominion Iron and Steel Company have secured Mr. Arthur J. Moxham as manager we may expect to see the plant in operation in a very short time. Mr. Moxham can be depended upon to make things go with a rush. He is a hustler and will lose no time in pushing the works to completion. He is a man of extraordinary force and business capacity and is noted for the success which has attended all his enterprises. No man could be found better fitted to take the management. He has had practical experience in all the details of manufacturing iron and steel and is a splendid organizer and manager of men."

Mr. Arthur J. Moxham is an Englishman by birth, but went from England to Kentucky in 1869, at the age of fifteen. His family held a very good social position in England, although they were in reduced circumstances at that time and it was thought that he could not learn a trade in that country without injuring the standing of the family, but he had a natural bent for mechanical work and being anxious to make his own way decided to come to America. Starting in a rolling mill in Louisville in 1870

as receiving clerk, he afterwards obtained practical experience of every department of the work and mastered all the details of the business. Upon the failure of the company as a result of the panic of 1873, the business went into the hands of a receiver, and Mr. Moxham, in association with some friends, leased the works and operated them with great success for some years. He afterwards organized the Birmingham Rolling Mills Company, and in 1878 built rolling mills at Birmingham, Ala. The works were completed and put into operation within eight months from the time of the preparation of the first plans. At this time he was only twenty-four years of age. The rolling mills practically doubled the population of Birmingham. While at Birmingham Mr. Tom L. Johnson approached him to undertake the manufacture of what was at that time a new type of rail now universally used for tramways and street railroads, being known as the "girder rail." He had endeavoured to secure its manufacture at many points, but owing to the difficulties involved in rolling this complicated shape in the state of the art as developed at that period had secured no one willing to undertake it. Mr. Moxham decided to experiment and after many difficulties succeeded. This led to a partnership between Mr. Johnson and Mr. Moxham. Out of this grew the Johnson Company, which became the largest manufacturers of street railway supplies in the world. Works were erected at Johnstown, Pa., for the manufacture of not only the rails, but the switches and other essentials. The rolling mills were built within a period of nine months from the time of breaking ground to the time of rolling the steel. The business continuing to grow, the erection of larger works became a necessity.

Up to this time the company had purchased the steel used in the rolling mills, but it was now decided to engage in the manufacture of steel, and after a critical investigation into the advantages of different points, Lorain, Ohio, on the southern shore of Lake Erie, was selected as the best location for the new works, and the company erected there a large Bessemer steel plant, together with the necessary blooming mills and rail mills. The work of construction was commenced on the first of July, 1894, and the first steel was made on the first of April, 1895, a period of nine months, although predictions were freely made that the plant could not be started in less than from eighteen months to two years. Blast furnaces for the manufacture of pig-iron were afterward built. About 4,000 acres of land were secured and simultaneously with the construction of the works what was practically a new town was built with all such public improvements as were involved in the supply of water, laying out of streets, building sidewalks, constructing sewers and laying water pipes. A virgin forest had to be removed and about eighty tons of dynamite were used in clearing away the trees alone. The population of Lorain was increased by these works from 5,500 to 11,000 within two years and that of Elyria, an adjoining town,

by about 2,000. The works were afterwards greatly extended and the number of employes largely increased.

The Lorain Steel Company's plants were sold to the Federal Steel Company, as one of the great concerns formed by the consolidation of several large steel companies is called. The Lorain plant was the second unit, of manufacture under the amalgamation. Mr. Moxham, who was president of the Lorain Steel Company at the time of the amalgamation, remained with the Federal Steel Company in the same capacity until the 22nd of March, 1899, when he tendered his resignation and retired for the purpose of withdrawing from all business. He had sold his interest in the Lorain Steel Company, and having now a competence determined to take a rest after thirty years of hard work. He purchased the well-known yacht *Erl King* and started on a tour of two years around the world. During the past summer he visited the British Isles and went as far north as Norway, but happening to stop at New York after a yachting trip of about four months, he accidentally met Mr. Henry M. Whitney, with whom he was well acquainted, having had extensive business dealings with him at the time when Mr. Whitney was president of the West-End Street Railway of Boston and inaugurated the first great electric street railway system.

From Mr. Whitney he learned of the great developments in progress at Sydney, Cape Breton, and having great confidence in Mr. Whitney's business judgment he at once became greatly interested in what he said about the great natural advantages of Sydney as a location for an iron and steel industry. The course of Mr. Moxham's experience from 1870 to 1895 had been in a strict line with the changed conditions of steel manufacture, each new step having been made in what may be termed the centre of gravity of most economical production as this changed owing to the development of the country and the discovery of new localities for raw materials. He was much impressed with what he heard about the cheapness with which the raw materials for iron-making could be assembled at Sydney and decided to make a thorough investigation. He not only visited the locality himself, but sent an expert to examine the ore deposits of Great Bell Island, and after a month's careful study of all the conditions he came to the conclusion that iron and steel could be made more economically at Sydney than anywhere else and decided to accept an offer to become manager of the company and invest in its securities.

It will be a source of gratification to Canadians that a man of such practical experience in the manufacture of iron and steel as Mr. Moxham has formed the opinion that Canada possesses the best location in the world for the manufacture of iron and steel.

Canadians in general will be pleased to know that the manager of this great enterprise is a British subject, although

this fact had nothing whatever to do with his selection for the position.

Mr. Moxham, although a resident of the United States for thirty years, never became naturalized. This was at one time made a matter of reproach in the United States Congress, and Congressman Johnson, of Ohio, in defending him, said: "This man Moxham is not a citizen of the United States, but he is a resident of Johnstown; they know him there, and when that fearful flood swept down; when, after that awful night, twelve thousand people were left without food or shelter, and the sun rose on three thousand corpses, it was this Englishman, this Arthur J. Moxham, who at the first gathering of the survivors, was by common acclaim made dictator. It was he who in that dreadful moment, stepped to the front, and, in the name of the whole community, brought order out of chaos—who destroyed whiskey and seized food, who fed the living and buried the dead, and again set in motion the machinery of organized government and civilized life."

